SUCCESSES IN THE SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

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Executive Summary

SUCCESSES IN THE SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

The Small Business Innovative Research (SBIR) program enables small businesses to participate in DoD-sponsored research and development. The program reaches a variety of small businesses from one person working independently to established companies with several hundred employees. Participants like the program and are enthusiastic about continued participation. As a result of the SBIR program, new products and processes are being introduced into the DoD inventory. Many of the products have commercial applications as well.

DoD's SBIR program is a congressionally mandated program wherein a small percentage of its R&D awards are set aside exclusively for small businesses. Its objectives are to stimulate technological innovation in the private sector, to strengthen the role of small business in meeting DoD research and development needs, to foster and encourage participation by minority and disadvantaged persons in technological innovation, and to increase the commercial application of DoD-supported research and development results.

Research under the SBIR program covers virtually all scientific disciplines. For example, the Army has funded projects to provide potable water to troops when local water is unavailable or undrinkable. The Navy has funded several proposals involving tools and materials that can be used underwater. A project to develop a safer way to manufacture explosives may provide a new processing technology that can be applied to many other products, both commercial and military.

The projects studied for this report were begun in FY83 and FY84. Many are on the verge of commercialization, while others that show great promise are still in the final stages of development. We note, however, that the chance of success is increased if the project has a "champion." The supporter within DoD may only provide increased visibility, but often this can provide that extra impetus to make an idea a success.

To improve the program, we recommend that the Director of the Office of Small and Disadvantaged Business implement the following:

- Emphasize to the Services the importance of a product champion as a way to achieve maximum benefit for DoD.
- Stagger the solicitation over the year to ease the proposal preparation burden for the smallest companies.
- Provide an informational pamphlet on accounting for Government contracts.
- Encourage the Services to provide more feedback on both winning and losing proposals.

In summary, the SBIR program has enabled small businesses to participate in DoD research and development. The program has produced some very promising technology as well as products that DoD is now using. The SBIR program is a program where both Government and business win.

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CHAPTER 1

SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

INTRODUCTION

DoD's Small Business Innovative Research (SBIR) program was established to stimulate technological innovation in the private sector, strengthen the role of small businesses in meeting DoD research and development needs, foster and encourage participation by minority and disadvantaged persons in technological innovation, and increase the commercial application of DoD-supported research. For SBIR purposes, a small business is any U.S. business organized for profit with no more than 500 employees. The premise of this program is the long-standing American conviction that individual entrepreneurs can often come up with the solution to big problems. This faith in the virtue of smallness was confirmed in a 1968 study that attributed 41 of 61 important modern innovations to independent inventors or smaller firms.[1] These 41 include such well-known contributions as the Polaroid Land camera, penicillin, xerography, catalytic cracking of petroleum, the safety razor, and the ball-point pen.

We assessed the progress of the SBIR program in the Army, Navy, Defense Advanced Research Projects Agency (DARPA), and the Defense Nuclear Agency (DNA). We found that the SBIR program is achieving its goals; the small business community is enthusiastic about the program and new products and processes are being introduced into the DoD inventory. Many of the more successful projects have potential commercial applications for the products or processes in addition to a military application. The participants believe the program is fair and generally well-administered. However, on the basis of our assessment and comments from the participants, we recommend that the Director of the Office of Small and Disadvantaged Business take the following actions:

- Emphasize the importance of "product champions" within the Services as a way to gain the maximum benefit from SBIR projects.

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[1]Jenkes, John, David Sowers, and Richard Stillerman. *The Sources of Invention*. p. 73. New York: St. Martin's Press. 1968.

- Stagger the solicitation and award of SBIR contracts over the year to ease the proposal preparation burden for smaller companies.
- Provide all participants with an informational pamphlet on accounting for Government contracts.
- Encourage the Services to provide more feedback to the companies on both winning and losing proposals.

THE SMALL BUSINESS INNOVATIVE RESEARCH PROCESS

Funding

The SBIR program is a follow-on to the voluntary Defense Small Business Advanced Technology program started by DoD in 1982. On 22 July 1982, the President signed Public Law 97-219, the *Small Business Innovation Development Act of 1982*. That law gave small, high-technology firms a greater share of Federal research and development contract awards.

The SBIR Act requires all Federal agencies to establish an SBIR program if their FY82 budget for research and development funds directed to contractual actions, excluding in-house expenditures, exceeded $100 million. The act directs that 0.1 percent of the R&D budget be set aside for SBIR awards. This percentage was required to increase each year until by the fifth year it reached 1.25 percent. DoD is one of the Government agencies that meet the requirements for having an SBIR program. DoD's goals and awards are shown in Table 1-1.

TABLE 1-1

DoD'S SBIR GOALS AND AWARDS BY YEAR

Fiscal year	Statutory percentage	Estimated dollars	Dollars awarded
1983	0.10	16.7 million	20.6 million
1984	0.30	43.0 million	44.6 million
1985	0.50	79.0 million	78.2 million
1986	1.00	150.0 million	150.7 million
1987	1.25	204.0 million	202.0 million
1988	1.25	220.0 million	N/A

Note: N/A = not available.

The level of expenditure will continue at the 1.25 percent assessment of the research and development budget through 1993 but now excludes from assessment those amounts of the DoD research and development budget obligated solely to develop operational systems.

Solicitation Process

Agencies identify research areas that support their mission requirements, and submit them as topics for the annual solicitation. The Small Business Administration issues a presolicitation brochure listing the topics about a month before the formal DoD solicitation is issued. DoD's formal solicitation contains detailed topic descriptions or statements of need, solicitation procedures, and the sponsors for proposals for each topic. The DoD solicitation contains topics from the Departments of the Army, Navy, and Air Force, as well as DARPA, DNA, and the Strategic Defense Initiative Organization.

SBIR Program Phases

The SBIR program consists of three distinct phases. Phase I determines the scientific or technical merit and feasibility of ideas or concepts submitted in response to the SBIR solicitation. Since all DoD topics address specific R&D needs to improve the defense posture, proposals selected for contract award are those which contain an approach or idea expected to answer a specific problem. Phase I awards are for one-half to one person year, usually not exceeding $50,000.

The principal research and development is done in Phase II, which requires a more comprehensive proposal outlining the effort in detail. Projects are considered based on the results from Phase I, and the scientific and technical merit of the Phase II proposal. The number of Phase II awards depends upon the success of the Phase I project and the availability of funds. Phase II awards typically cover 2 to 5 person years of effort over a period generally not to exceed 24 months, subject to negotiation. Awards generally do not exceed $500,000. Special consideration is given to proposals which identify a follow-on Phase III funding commitment from non-Federal sources.

Table 1-2 shows the DoD SBIR program for FY83 and FY84. As can be noted from the table, many more proposals were received than could be selected and funded for Phase I – just under 10 percent were selected. However, once selected for Phase I, almost half of the projects were selected to proceed to Phase II.

TABLE 1-2

SBIR PROGRAM PROPOSALS AND AWARDS BY PHASE AND MILITARY SERVICE

FY83 and FY84

Military Services[a]	FY83 program				FY84 program			
	Number of topics	Proposals received	Phase I awards	Phase II awards	Number of topics	Proposals received	Phase I awards	Phase II awards
Army	182	1,121	98	45	111	761	81	33
Navy	131	944	66	45	147	847	99	52
DARPA	8	128	12	8	17	107	15	7
DNA	10	88	8	2	8	80	12	0
Total	331	2,281	184	100	283	1,795	207	92

[a] Excludes Air Force.

Phase III does not involve SBIR funding. Participating companies are expected to acquire private-sector investment and support for any development necessary to bring an innovation to the marketplace. Also under Phase III, DoD may award follow-on contracts outside of the SBIR program for products or processes that meet DoD mission needs.

Defense Technical Information Center SBIR Support

DoD provides technical literature packages to assist small businesses wishing to participate in the DoD SBIR program. This information helps a small business decide whether or not to bid on a topic and ensures more relevant and technically stronger proposals. Since the inception of the program most Phase I winners have taken advantage of this assistance.

Selection Criteria

Phase I proposals are evaluated on a competitive technical basis by knowledgeable scientists and engineers in the organization that generated the topic. Evaluation is made in accordance with the following criteria:

1. The scientific/technical quality of the research proposal and its relevance to the topic description, with special emphasis on its innovation and originality
2. Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities
3. Anticipated benefits of the research to total DoD research and development requirements
4. Adequacy of the approach proposed in Phase I to demonstrate the feasibility of the concept.

Reviewers base their conclusions entirely on information contained in the proposal. Final funding decisions are made on the basis of the criteria stated above while also considering duplication and the overall program balance.

Phase II proposals can be submitted only by Phase I awardees; they are not initiated by a solicitation. Awardees can submit Phase II proposals when they believe sufficient Phase I progress has been made to justify Phase II. The proposals are evaluated under the same criteria listed above for Phase I, plus the degree to which Phase I objectives were met and the reasonableness of the proposed costs. For proposals of approximately equal merit, a follow-on Phase III funding commitment for continued development from non-Federal funding sources will be a special consideration.

Phase II proposers who wish to maintain project continuity must submit proposals no later than 30 days before the expiration date of the Phase I contract and identify the work to be performed for the first 4 months during Phase II and its cost. A modification of the contract may be issued to cover an interim period of 4 months or less while the total Phase II proposal is being evaluated and a contract is being negotiated.

STUDY METHOD

Contact was made with all 192 companies whose projects were begun in FY83 and FY84 and were chosen to proceed into Phase II. The projects were done for the Army, Navy, DNA, and DARPA. Air Force projects are excluded from this report. We limited our examination to projects begun in FY83 and FY84 because of the long lead-times required for research to produce results. Fifty-five companies provided us with information on 62 SBIR projects. Findings, conclusions, and recommendations are presented in Chapter 2. The nine case studies of projects with exceptional promise are in Chapter 3. Appendix A contains a summary of all 62 projects. Each summary states the objectives and accomplishments of the project, including commercial use or other spin-off technology that evolved from the initial SBIR contract. It also describes any plans for Phase III that move the project from the SBIR program into a mainstream DoD contract or into commercial production. During our research, participants offered comments and recommendations, which are summarized in Appendix B.

CHAPTER 2

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

DEFINING A SUCCESS

Success can be measured in a number of ways from the point of view of an SBIR participant. Most companies appreciate the opportunity to grow; in size, skills, and areas of expertise. Many have been able to develop ideas only because of the financial support of SBIR. But the goal of the SBIR program is to produce new products and processes that DoD can use; it has done that too.

For DoD, successes might be divided into three types. The first type is the traditional idea of success: those products or processes that can be sold commercially. The second type is products that fill special military needs such as electronic countermeasures or munitions: those products may not have commercial applications but they will continue to be bought by DoD under standard contracting procedures. The third type of success is those projects wherein the product produced in Phase II satisfies DoD's requirement for those goods or services and no follow-on production is expected. Two examples are software for a specific application and one or two prototypes of a specialized laboratory instrument.

EXAMPLES OF SUCCESS

The ultimate success of SBIR projects cannot be fully measured at this time because research can take a considerable amount of time to produce results. However, Appendix A, which summarizes 62 SBIR projects initiated in FY83 and FY84, includes examples of each type of success.

One project with commercial application is the development of a sea water rope battery for use on the ocean floor. The battery, which uses aluminum wire and its corrosion current along with dissolved oxygen, is safer and less expensive than the lithium batteries now being used. A second product with potential commercial applications is a robotic deck scrubber developed for the Navy. The technology can be applied to mobile robots that need to avoid obstacles to perform their tasks.

Mobile robots could be used to clean warehouses, to clean up toxic waste, and in fire fighting and security patrolling.

As expected many projects are developed for military-only applications. The Army sponsored a project to develop a prototype digital filter that uses radar to discriminate aircraft from chaff dispersed as a decoy. The Navy funded a project to develop an on-the-bottom surveillance buoy that can be carried by Navy antisubmarine warfare aircraft.

The third class of successful projects contains those that require a limited number of deliverables to satisfy the need. One company developed a thermal target projector demonstrator to train thermal imaging operators. The five units delivered under Phase II are all the Army requires for training. The Navy-funded development of a software program to evaluate emerging technologies with respect to risk, cost, and potential payoff. The task was complete upon delivery of the program and documentation.

PARTICIPANT'S CONCLUSIONS

The most encouraging finding of this study is that the SBIR program is well liked by all of the companies participating. All the comments on the program as a whole were positive and many firms would like to see the program expanded. Many companies attribute their opportunities to grow and to develop new products or areas of expertise to the SBIR program.

Participants consider the program to be well managed and fair, even though highly competitive. The contractors appreciate the abbreviated proposal size that is used in the SBIR program. This has enabled many of the small firms to develop winning proposals who might not have been able to cope with more elaborate proposal requirements. Still, for some of the very smallest firms, with only one or two people, trying to prepare more than one proposal in response to the DoD combined solicitation proved very difficult.

By far the biggest problem with the administration of the program is the funding gap that often occurs between Phase I and Phase II of the program. Because of their small size, any gap in funding causes a severe hardship for most of the companies. They find it hard to keep the program going and to maintain their project teams once the flow of funds has ceased. An additional difficulty faced by the

companies is conforming to the accounting requirements of the Government. Although most of the SBIR Phase I awards are fixed-price type contracts, Phase II awards are usually cost-type contracts and, as with any cost-type contract, that requires that the contractor's cost accounting system accurately record costs chargeable to the Government and avoid mischarging other costs. This requirement and the process to verify it have been very confusing to many new SBIR contractors.

Several of the companies expressed the desire for more feedback or more timely feedback. For example, win or lose, they want to know how well their proposal met expectations and where it fell short. Proper debriefing is not now routinely provided to the losing offerors. In addition, the bidders would like to receive synopses of the results of successful programs. Some believed that their firms would become better known within the Government or by other potential customers if there was better communication between the Government and the contractor throughout the program.

The requirements of Phase III often present major problems for these small businesses. Most of the small research and development firms seem to have been started by people who are highly skilled technically, but who lack marketing skills. Partially as a result of this, marketing the newly developed product is a big challenge. Within the Government, an active proponent of the idea being explored, a "product champion," is important. This person can provide important contacts within the Government and help the company with a promising product or process to compete for a regular Government contract as part of Phase III. Without such a person, the innovative idea or approach may never be fully used.

SBIR participants also have difficulty finding Phase III funding in the commercial world. Their experience has taught them that venture capitalists are reluctant to invest in new, unproven technology. Also, large companies are not always eager to license new products, particularly if they might compete with other products the company produces. The SBIR participants have tried a number of marketing strategies; some have been able to license products or find a company willing to market their product. Many have decided to undertake the remaining development and marketing with their own internal funds.

A final, if not new, conclusion is that research and development takes a long time to bear fruit. None of the programs that started in FY83 or FY84 has reached

the point where it is clear it can be called an unqualified success in either the DoD or commercial market. Although the participants have made substantial efforts to market their products, it will take more time before the results are in. Those firms that appear to have the best potential for financial success based on the SBIR program are those that have found a commercial need for their research or idea in addition to the DoD application.

CONCLUSIONS AND RECOMMENDATIONS

The SBIR program was found to be providing new products and new technology and was thus fulfilling its purpose. It is not a welfare or support program for small business: products are delivered, services are provided. At the same time, it does provide support to small, innovative businesses, many of whom have grown significantly as a result of the program. In addition to growth in size, many have grown in depth of expertise and in their ability to hire more highly qualified personnel. In a few cases, an SBIR project has so much potential that the company has changed the focus of its work to concentrate on the area started with SBIR financing.

Based on the findings and conclusions of the study, we recommend that the Director of the Office of Small and Disadvantaged Business Utilization (SADBU) make the following minor changes in the administration of the program to alleviate some of the contractors' concerns. These can be accomplished at little or no cost.

We recommend that DoD stagger the SBIR solicitation to ease the burden for the smallest companies. Since the DoD solicitation is issued in one volume, with a single response date, the smallest companies have a difficult time submitting multiple proposals. If they are not successful, they must wait a full year for another chance. An easy solution is to issue solicitations for each agency separately, spread through the year. An alternative is to issue several smaller DoD solicitations through the year.

Meeting Defense Contract Audit Agency requirements for Phase II cost accounting frustrates many firms. An SBIR participant suggested that one SBIR topic be devoted to development of a personal computer (PC)-type model system that could be updated as necessary. However, cost accounting programs for PCs are commercially available. We recommend DoD consider gathering information on

accounting procedures and available systems and publishing an informational pamphlet for offerors.

The SADBU office should emphasize to the Services the advantages of a product champion as a way to achieve maximum benefit from the program. It is difficult even for a very successful SBIR project to obtain a Government contract for Phase III because the procurement process is separate from the SBIR program and has somewhat different rules. The timing and funding have to come together at the right time to support the idea or it may get lost in the press of other business. A product champion can see to it that the idea enters the mainstream and is not forgotten. The SADBU office also must communicate more clearly to the companies the need for effective marketing, both within the DoD and to commercial markets.

We also recommend that the Director of SADBU act on participants' suggestions for more information. Inform SBIR participants of the status of their proposals as quickly as possible. The firms want to know the results and if not selected, what they can do to submit a better proposal next time. Companies whose proposals are not accepted should be encouraged to ask for a debriefing and winners should be notified promptly. This is important for both Phase I and Phase II proposals. In addition, research firms want to know about other research under the SBIR program. All offerors could be provided synopses of research results, using company-generated abstracts from the final research reports, similar to the abstracts in the notice of awards now issued.

CHAPTER 3

CASE STUDIES OF SUCCESSFUL SMALL BUSINESS INNOVATIVE RESEARCH PROJECTS

INTRODUCTION

There are many successful SBIR projects that originated from the FY83 and FY84 Phase I awards. Appendix A provides brief descriptions of each project for which information was available from the contractors. Out of these, nine were chosen to be presented in detail.

The cases chosen span a wide variety of topics and applications. The first case is a materials processing technology application, an area in which the United States has been criticized for being behind other industrialized countries. This process has both military and commercial applications.

Others, such as ruggedized computers, are primarily for military benefit. Also, a project can start from a purely military problem, for example in rubber-to-metal bonding, but make breakthroughs that may have much more effect in the commercial market. Still others, like knowledge elicitation models, are broadly applicable to many areas both commercial and military.

The remainder of the chapter presents the following nine studies:

- General Technology Applications, Inc. – Using cryogenic processing to manufacture munitions safely
- Klein Associates, Inc. – A method to elicit expert's knowledge
- Texas Research Institute, Inc. – A better way to bond rubber to metal
- Foster-Miller, Inc. – A portable, personal cooling system
- Foster-Miller, Inc. – An improved piston seal for extreme conditions
- R-K Research and System Design – A computer-aided instruction (CAI) program and on-line help system
- KMS Industries, Inc. – Ruggedized computers for use in the field

- Charles Evans and Associates – Better quality control for exotic wafers for electronic chips
- Ophir Corporation – A rugged infrared marine hygrometer to support targeting of modern weapons.

CASE 1: GENERAL TECHNOLOGY APPLICATIONS, INC.

Just as 5,000 years ago man ushered in the Bronze Age by discovering that metals could be combined to produce new materials by melting them, so today, science is using cryogenics and mixing materials at very low temperatures to create new compounds.

Under an SBIR project General Technology Applications, Inc. (GTA) applied cryogenic processing to develop a safer, cheaper way to produce gun and rocket propellants. They are now applying the technology to the production of higher quality, lower cost tank tread pads. GTA is working with the Navy to set up a pilot facility to produce propellants at Indian Head, Maryland. Eventually, GTA expects to produce both propellants and tank tread pads at the Army's facility in Joliet, Illinois.

The Company

GTA, a privately held corporation founded 11 years ago, is located in Manassas, Virginia with 12 employees. The president of the company believes "the SBIR program has made all the difference in the world" in their ability to move forward with development of this process. He finds that the willingness to take development risks with new technology is much higher within the Government than it is in large corporations. "On the basis of 25 years experience in the U.S. Navy R&D establishment and 20 years in private industry R&D activities, I consider the SBIR program the most successful approach to tapping the well springs of innovation . . . ."

Benefits of Cryogenic Processing

GTA's proprietary cryogenics process uses liquid nitrogen to cool materials to about minus 100 degrees celsius for grinding and blending. At these low temperatures, the materials are easier to grind and combine with other ingredients to form new materials. The major advantage of cryogenic processing for making explosives is that the materials are inert at low temperatures. This means that chemical reactions do not take place and highly reactive materials that would explode if processed at ambient temperatures can be combined safely. Some materials that cannot now be combined under ambient conditions can be blended under cryogenic conditions, to produce entirely new materials. Also, because the

materials remain inert, the blending process is insensitive to time: materials can be blended more thoroughly to form a more homogeneous composite.

The GTA cryogenic process has additional benefits of safety and less chance of contamination. The pulverized materials are mixed with liquid nitrogen and can be treated as a liquid that is processed within a closed system. Employees are not exposed to the materials and impurities are excluded because the system is enclosed. Liquid nitrogen cleans the particle surfaces of some materials and makes them nonagglomerating (nonclumping), which also increases homogeneity and reduces impurities.

GTA states that their processing technology will be less expensive than using heavy mechanical grinders and mixers in many cases. Liquid nitrogen is inexpensive and mixing the materials with liquid nitrogen in a closed system requires smaller, lighter machinery. This smaller, lighter equipment is less expensive than the grinding equipment currently in use. GTA asserts that the process also uses less energy than mechanical grinding technology.

GTA's SBIR Program

GTA is working on two military applications of cryogenic materials processing. The first application developed under an SBIR award, provides a safer way to combine the highly explosive ingredients used in high-performance gun and rocket propellants.

Under Phase II, GTA demonstrated the feasibility of manufacturing propellants under cryogenic conditions and worked with the Navy facility at Indian Head to establish a pilot manufacturing facility. The GTA processing technique will be validated at Indian Head using actual explosive materials. After the pilot plant testing, GTA expects to receive a follow-on contract to produce propellants at the Army facility in Joliet.

The second application evolved from the SBIR work but was not actually funded by it. GTA is being funded by the U.S. Army Materiel Command to explore use of cryogenic processing to produce tread pads for the M-1 battle tank. Replacement tread pads for tracked vehicles are a $250 million per year program and the current products are not totally satisfactory.

Tank tread pads are made from a rubber base into which wear-resistant materials are impregnated. The production of the rubber tank pad mixture can be compared to the vulcanization of rubber. Currently, in vulcanization, heavy grinders tear the rubber into microscopic pieces and the vulcanizing agent is blended in. The grinding process is mechanical and cannot produce uniformly small pieces. Also, the heat produced in the grinding and blending process starts the vulcanizing process before the materials are completely blended and that introduces minor flaws in the final structure of the material. Cryogenic processing eliminates both of these problems. Because the materials remain inert when they are ground and blended, they do not react with each other, and because the products can be blended more evenly, the final product has fewer flaws. The tank tread pads would be produced at the Joliet plant also.

Commercial Application

Outside the SBIR program, GTA uses cryogenic processing to produce two commercial products. The first is a product called *Elastol*, used for cleaning up oil spills. *Elastol* changes the surface tension characteristics of the spilled oil, making it possible to suction up the oil without taking up water at the same time. GTA's product makes it possible to literally lift the oil off the surface of the water instead of dispersing it the way other additives, now in use, act. The recovered oil can be reused because it is not contaminated with water. In addition to its superior performance, *Elastol* is less expensive than other additives. The worldwide oil spill clean-up market is about $50 million per year. Canada has approved the use of GTA's *Elastol* for any oil spill in its waters and several European countries are now testing the product. The second commercial product is an additive for oil pipelines that enhances the flow of oil and other liquid fuels. The company would like to increase sales to the point where a major marketer of additives will license the marketing of both products.

The company has identified numerous other commercial applications that they would like to explore. For example, there is a bottleneck in producing superconductivity materials because they take a long time to produce and can only be produced in small quantities. Cryogenic processing may be able to produce larger quantities in shorter periods of time. There are potential applications for these techniques in the production of adhesives, ceramics, and in powder metallurgy.

CASE 2: KLEIN ASSOCIATES, INC.

The science of behavioral research has moved from observing rats in a maze to very sophisticated forms of what is now called knowledge engineering. Klein Associates, Inc., has developed training techniques for decision making under pressure situations and for the sharing of expertise by developing very subtle observation and interviewing techniques.

The Company

Klein Associates, Inc., located in Yellow Springs, Ohio, was started about 5 years ago with 4 persons and now has a staff of 12. Significant growth is expected in the next 2 years based on the commercialization of their approach to knowledge engineering.

> "The SBIR program has been of extreme value to us. It has allowed us to develop our methods into knowledge-engineering products, and it has changed our thinking about the type of company we are. . . . this SBIR has turned into the central focus of my company."

Knowledge Engineering

Klein Associates wanted to develop methods to study the decision-making processes used by military commanders in high-pressure situations. This research started under an SBIR topic for the Army Research Institute for the Behavioral and Social Sciences and continues to be pursued under basic Army research contracts. The work resulted in a method for capturing military group decision-making dynamics for use in training feedback and analysis. As a continuation of this project, the company was asked to further develop the knowledge elicitation methods that they had used to study the decision-making process. Phase II of the SBIR contract involved understanding the decision process of the experts without interfering with the process.

Most often when we think of the resources of an organization, we think of the equipment, buildings, land, etc., but often overlook the expertise of the people who work there. As a result, this expertise is lost when the people move on. This is a particular problem in America due to the high mobility of the population compared to the relative stability of other countries' work forces, say, Japan for example.

Once you realize that there is a valuable resource in the knowledge of the workers, the challenge is to extract that expertise to make it more widely available to less expert workers. Klein has developed an interviewing technique to elicit expert knowledge. As shown in the following examples, the technique can be applied to any job that requires expertise.

Examples

Experts

It takes nurses at least 2 years to become experienced on neonatal intensive care units and it is important that, if they leave that work, their expertise does not leave with them. For example, there is a great danger that infants under these difficult circumstances may develop sepsis, a generalized infection, nearly always fatal. Laboratory tests can easily distinguish sepsis, but by the time lab tests confirm it, it may be too late. The best line of defense is the experienced nurse who can tell when immediate treatment is needed. How can they tell? If asked they usually cannot say, but the information can be discovered by carefully interviewing the nurses, and having done so, the expertise can be packaged into a training program to transfer it to others.

Market Research

Over the years, market researchers have developed very powerful techniques to do questionnaires and sampling, but they have not spent as much time on the question of how consumers actually make the decision on which product to buy. How is the product picked? Klein Associates used the methods developed in the SBIR task to talk to a sample of consumers about their buying decision process. They discovered that consumers found each product had some negative features that they did not like. As a result, they would buy the cheapest brand that did not have the negative features. While consumers liked positive features of certain brands, they would not go out of their way to get (or pay for) them. In fact, consumers were often suspicious of new features that had been added.

Military Decision Process

The decision process used by the operations staff during a military exercise planning session that lasted over 6 hours was charted in detail. Klein Associates found that planners would evaluate a single concept by gradually examining deeper

and deeper branches of the idea for feasibility until it was either accepted, rejected, or left hanging as the result of some distraction. If it was rejected, the planners either moved to an entirely different concept or went back up this progressively deepening chain to a point above the flaw and proceeded to follow another branch. It was also discovered that few such discussions were carried to a final decision: most were interrupted for one reason or another. Only 8 percent of the transitions were made because the original topic was resolved while nearly 30 percent were caused by unrelated questions which led to an abrupt change in topic. These data suggest a lack of adequate control over the team decision-making process.

Klein Associates was able to provide feedback at the debriefing immediately following the exercise. Using a data collection form, they were able to flowchart the decision-making process relatively quickly. Data charts were also produced which showed the amount of participation by each staff member and the frequency with which the various discussion processes, such as change of subject, occurred. For the 6 hours 17 minutes analyzed in depth, there were 60 changes in topic, most of these unintentional.

Klein Associates was able to track most of the team processing without interfering with the exercise using their data collection form. The form, when supplemented with general observation techniques, permitted the production of four types of decision-making performance feedback: illustrative incidents, general patterns, process flowcharts, and quantifiable data. The process flowcharts allow the players and instructors to review the exercise in detail. They can look at the charts and see the options generated and where, when, and why the participants stopped pursuing them; and they can identify the information input and follow what was done with it. The flows and quantitative data are also useful to model the naturalistic tactical decision-making process and to evaluate decision-making performance.

Training

In a study of computer specialists they found that those who were rated the best had superior methods of working with people. It was discovered that the highest rated specialists realized that their customers could not describe exactly the nature of computer services wanted, so they worked together to define what was needed.

Klein Associates documented the differences in these approaches and developed training material based on the successful techniques.

Avoid Generalizations

The key to Klein Associates' method of eliciting the knowledge held by the expert is to listen to that person's stories and to discourage the person from trying to generalize about their expertise. You can learn the most by studying nonroutine events and how the expert adjusted to them. Routine events will not call forth the level of expertise that you want to study and the expertise will not apply if the events are too unusual. The best kind of event to study is one in which the expert had to stretch, but could cope with the situation; in stretching, the expertise becomes visible.

Studying critical decisions shows how the expert behaved in a specific case. Their wisdom comes from these events, not generalizations. In the past, it was thought that the researcher should codify all expertise to make it more general. However, this is not a good approach. In gathering the information, generalization must be avoided: only during training should generalization occur.

Commercial Markets

There are several separate parts to the huge market for these services. First is the general skills training market. Second is the expert systems development market. Third is the market research environment. Finally, there is an organizational development market. The process that was developed during the SBIR task is a general process that can be applied to many different purposes. In addition to its participation in the commercial market, Klein Associates continues to develop the decision-making area under basic Army research contracts.

CASE 3: TEXAS RESEARCH INSTITUTE, INC.

It may come as a surprise to many that the hull of an attack submarine is perforated with about 1,200 6-by-8-inch rubber windows to allow sonar signals to pass through. The bonding of these rubber windows to the metal hull under the extreme pressure of submerged operation in corrosive sea water is a constant maintenance problem. After about 180 seals fail, the sonar will not function and the submarine must be withdrawn from duty for repair. Texas Research Institute (TRI), Inc., has developed an improved long-lasting bond for these window seals.

The Company

TRI, Inc., of Austin, Texas, was started in 1975 to pursue work with analytical chemistry and plastics. It began with a permanent staff of 2 full-time and 1 part-time employees and has now grown to 210 persons. Most of this growth has been internal although they have acquired two small companies. Since the start, the firm has had about a 40 percent growth rate each year. In 1983–1984, they topped $1 million in sales for the first time and expect about $10 million in sales in 1988.

While the SBIR program is only a small portion of their work, the president of TRI says, "I believe the SBIR program is good for DoD, the small business community, the academic community, and the nation as a whole."

Benefits of Better Bonding

In order to use sonar, sound must be transferred from the mechanical workings of the sonar transducer's mass through the many rubber windows in the sides of the submarine into the water. When 15 percent of the window seals fail, the whole system becomes inoperable and the submarine must be drydocked in order to renew the bonds. This is very expensive and keeps the submarine out of service for an extended period. Extending the periods between overhauls would reduce the cost and time out-of-service. When this was tried, however, it was discovered that the window seals started to fail frequently within 2 to 6 years of service. The goal is to create a bond that will last 15 years.

Two pressures affect the bond: hydrostatic pressure and electrochemical pressure. Hydrostatic pressure is the pressure of the water against the window and becomes very severe as the depth is increased. An electrochemical reaction occurs

between the salt water and metal of the submarine. The hydrogen that is formed by this electrolytic reaction creates hydrolytes that have dissolved the bonds.

To help overcome these problems, TRI used a better adhesive and applied a protective coating to both surfaces. The protective coating, an inorganic coupling agent, bonds to both surfaces and the adhesive. The combination of improvements has resulted in a bond that is expected to last 15 years, as indicated by the accelerated testing it has been put through. While important for national defense, underwater rubber-to-metal bonding is a very limited market.

Another possible military application of this technique is battle-damage repair. The bonding technique can be used on any unprepared surface. For example, repairs could be made under battle conditions where proper surface preparation could not be accomplished. Suppose a truck or tank has had a hole punched through the metal in battle. The surface can be scraped or wiped off, the primer applied, and the adhesive used to bond a patch on the hole. In 5 minutes the bonding is complete and the vehicle can be returned to service.

Commercial Applications

It was discovered that the coupling agent also bonded to oily surfaces. This is very important as it allows a greatly expanded market for the product. For example, the automobile industry could replace many spot welding operations if oily metal parts could be satisfactorily bonded.

When automobile manufacturers receive steel, it has been coated with oil to prevent corrosion during shipping from the steel mill to the auto plant. In addition, the auto parts pick up additional oily material from the lubricants used in cutting machines and the stamping process. Because it would be far too expensive to try to clean off all this oil, automobile manufacturers must spot weld the steel parts together.

However, TRI has found it possible to apply its inorganic coupling agent on both pieces to be joined as a primer, and then apply the adhesive to complete the bond. The interfaces are important, not the material to be bonded, so this will work with any type of material. In automobile manufacturing, using an adhesive bond instead of spot welding will increase durability and crash worthiness.

CASE 4: FOSTER-MILLER, INC.

Portable personal cooling systems have come a long way from the days of the cardboard paddle fan that appeared on church pews in the summertime in an earlier era. The Foster-Miller, Inc., modern refrigerated vest version is based on miniaturization and space-age materials.

The Company

Foster-Miller is a 32-year old company located in Waltham, Massachusetts. It has about 175 employees and specializes in prototype development for many customers. The firm itself usually does not engage in final production but establishes licensing agreements with manufacturers.

"... this SBIR program established Foster-Miller, Inc., in a leadership position in the new field of portable personal cooling systems."

Benefits of Portable Personal Cooling

Persons who must wear air-tight protective clothing in hazardous environments, such as chemical warfare, fire fighting, toxic spills, or nuclear power plants, need cooling devices to maintain normal body temperature inside their suits. Existing systems use either ice-filled vests or compressed freon forced through capillary tubes and back to the atmosphere. The iced vests melt too quickly, requiring frequent, time-comsuming replenishment and the heavy freon unit must be back-packed by the wearer. To solve this problem, Foster-Miller has developed a 16-pound device that can cool a person for up to 6 hours.

Foster-Miller accomplished this by designing the smallest open-shaft compressor known. This miniature freon compressor fits easily in one hand. To drive the compressor, they also developed a small single-cylinder engine with a 1 cubic-inch displacement that can run on diesel fuel, gasoline, or jet fuel. Only the size of the fuel tank limits the time this system can run. Since it uses about 1 pound of fuel per hour, a 1-gallon tank would last about 8 hours. The fuel tank and cooling system now weigh only 16 pounds; further development will make the device at least one-third smaller and one-third lighter.

The actual cooling effect is created by chilled water running through the plastic vest that covers the wearer from the shoulder to waist. The vest is seam-welded to

form small channels that direct the flow of about one-half pound of water. This chilled water flowing next to the body is a very effective way of keeping cool. The returned water warmed by the body is cooled by a small heat exchanger at the power unit.

The temperature can be regulated by the wearer by adjusting a thermostat that senses the temperature of the water as it returns from the wearer's vest.

Expanded Applications and Benefits

Because the original unit uses an internal combustion engine vented to the open air, it cannot be used in an explosive atmosphere. This danger can be avoided by using a battery or an extension cord connected to a power outlet. However, because batteries have such a low power-to-weight ratio, so far it is only practical to use a 1-hour battery.

CASE 5: FOSTER MILLER, INC.

Foster-Miller has also been successful in a project using ventilated band seals. Most automobile owners are aware that the pistons in the engine are circled with piston rings. Some know that their purpose is to maintain a seal around the piston as it moves in the cylinder so the fluids in the chamber do not escape down the side of the piston causing a great loss of efficiency. Most people do not know that piston rings are highly developed in terms of design, metallurgy, and finish. In another of its development areas, Foster-Miller has been exploring the design, metallurgy, and finish of piston rings for special applications.

The Ventilated Band Seal

Rings are not only used in the pistons in engines, but on the pistons in reciprocating compressors as well. In some applications, such as compression of oxygen, the piston seal must not require lubricant, which would explode on contact with the compressed oxygen. In such applications a piston ring with good sealing properties that will operate a long time is required.

Foster-Miller has developed ventilated band seals that overcome several of these problems. Instead of a normal piston ring, which may have a cross-section about the same as a coat hanger wire, these bands are about one-half inch wide. Still, they use the current pressure balancing technology with the loading distributed between the piston and the cylinder wall. During operation, there is a small fluid flow down past the band on each side: between the band and the wall, and between the band and the piston. The circumferential grooves on the surface of the bands help to distribute the load evenly and to maintain a good seal. Finally, the bands fit into special seats on the piston.

This ventilated band seal is an answer to special problems under extreme conditions. High-volume production of these special-purpose rings will never be required; this improved product would not have been developed in the commercial market or without the SBIR program. The combination of several existing technologies led to the success of this SBIR project and it can best be described as an ingenious application rather than as a breakthrough.

Uses of the Band Seal

For military purposes, a piston ring of this type is useful for low-heat-loss engines without cooling systems. These engines, known as adiabatic, require the very tight sealing that a ventilated band seal provides. It is believed that use of a fully developed ring of this type in an adiabatic engine would increase its efficiency by about 3 percent, an unheard of amount of improvement for such a highly developed technology. Another military use for an unusually high performance piston seal is in the development of nonmagnetic engines for use on minesweepers.

Commercial marketing of the ventilated band seal continues in that narrow niche for high-performance compressors that must produce high pressure without contamination. Since the military applications are designed for requirements not shared by industry, it appears high-volume production will not be achieved. Nevertheless two serious inquiries have been received regarding future commercial applications. Such a band seal could be used in homes or service stations to compress methane gas uncontaminated with oil for use in the family car.

CASE 6: R-K RESEARCH AND SYSTEM DESIGN

Obviously, the staff at Massachusetts General Hospital had a sense of humor when they developed the computer language that was to become the standard for medical use and called it MUMPS. It turned out to be a big success, in part because of its data storage efficiency and flexibility. R-K Research and System Design based their CAI program and on-line help system, called ABC, on the MUMPS language.

The Company

R-K Research and System Design, a very small company organized with only one full-time, regular employee, located in Malibu, California, will celebrate 20 years of operation in 1989. R-K assembles teams to provide the services needed on a case-by-case basis. In this case, five persons worked on ABC.

> The contracts that have been awarded under the auspices of the DoD SBIR program have provided us the opportunity to take a vision of a product from the design phase through to the development, testing, and evaluation stage....
>
> By far and away, this project has been the most significant R&D effort that we have been engaged in over the past 20 years. It would not have been possible without SBIR funding,.... We truly believe that the ABC system represents the essence of what SBIR is all about.

Computer-Aided Instruction

R-K Research and System Design developed a CAI module for the Navy Occupational Health Information Monitoring System (NOHIMS). NOHIMS was developed in the MUMPS language to collect, process, and display medical and environmental data for use in occupational illness and accident prevention programs. The flexible data storage format of MUMPS is ideal for storing information of variable length. ABC is a computer-embedded training system and on-line help system for users of NOHIMS. R-K continues the light-hearted approach to program naming by calling the ABC modules Able, Bill, and Carla.

ABC can be run on any PC using the MUMPS operating system with a 20 megabyte hard disk. This allows it to function as a portable classroom. One instructor can modify an ordinary portable PC with a readily available expansion board so that additional serial ports are available to plug in up to eight terminals.

The training program itself is so user-friendly that the instructor may not have to be on-site.

ABC Distinctions

ABC is perhaps the only generic CAI program that provides for interactive practice exercises and course modification without programmer intervention. The interactive portion looks just like the live system that the trainee is studying. For example, the training program can display the same screen for registering a patient that the student would see using NOHIMS. If there are changes to NOHIMS, the ABC program can have its instructional content easily changed by an instructor who is an expert in the subject matter without having to change any of the program itself. This could be thought of as being very similar to editing a document with a word processor so that the information differs, but the document remains. In the past, only a programmer could modify the instructional package.

There are several other possible expansions of this training system in the works. In one case it may be used for data processing training by a city water and power system. Also, it may be used by a prime contractor with the DoD in a project to provide training for users of a 700-hospital decentralized information system with the hope of saving many thousands of dollars in travel costs.

CASE 7: KMS INDUSTRIES, INC.

As we begin to see computers as necessary tools, we begin to want to take them out of the office into inhospitable environments, for example, aboard ships or into military command posts. Computer terminals that operate very well inside air-conditioned buildings don't function well in hot, humid, and dusty environments where they are subject to jolts and vibration. One solution is a fully militarized unit where each component is built to withstand severe environmental conditions. The primary problem with this approach is the very high cost for such units. KMS Industries (KMSI), Inc., has developed an alternative solution with ruggedized computers.

The Company

KMSI is located in Ann Arbor, Michigan, and employs 220 people. In 1987, KMSI formed an Advanced Products Division to design, develop, produce, market, and sell computer and communications systems and products to Government and industry.

KMSI was formed in 1967 to bring together a diverse, highly specialized group of companies to create the most advanced state-of-the-art products in their fields. During the first 15 months of business, KMSI acquired 14 companies, 1,000 employees, and a successful pattern of operation. The company's common stock traded publicly in 1968.

During 1969, the company began its pursuit of inertial confinement fusion (ICF) as the only private participant in the national ICF program. Unfortunately, by 1975, funding for the fusion effort required the company to sell off divisions one by one to maintain its ICF research. Financial and management restructuring were completed by 1980 and a business plan emphasizing diversification and steady growth was implemented.

> . . . the SBIR program is very beneficial to small businesses. It has enabled us to develop new customers and explore new research areas which may not have been attempted without the SBIR program. More importantly, it enabled us to initiate a major new business area for the corporation.

Benefits of Ruggedized Computers

Computers are available in four general versions: commercial, industrial, ruggedized, and military specification. Commercial computer terminals are office or home devices that are relatively fragile and must be used under environmentally benign and stable conditions. Industrial versions are designed to work in environments where there is more dust, dirt, heavier operator use, and some vibration.

The ruggedized version can handle more extreme conditions. It can be loaded into a truck in the rain, be carried over rough terrain, unloaded at a tent in a desert encampment with high temperatures and blowing sand, and still be expected to perform perfectly. In addition to withstanding the shocks of rough transport, this computer can also cope with the different type of higher frequency vibration levels found on shipboard or in aircraft.

The KMSI ruggedized version can operate at freezing temperatures or at over 120 degrees Fahrenheit. It can operate at altitudes of 10,000 feet or in high humidity. It has special filters that allow cooling while reducing the amount of dust that can accumulate within the case, but has still operated after over 2 pounds of fine dust had been drawn inside. And a ruggedized version costs about 10 percent of a fully militarized version.

The RMC-2000

RMC-2000 is the KMSI designation for their ruggedized model of an IBM-compatible PC that was specifically designed (not just repackaged) for use in harsh environments. All electronic components, including disk drives, are isolated against shock and vibration. The RMC-2000 is hardware compatible so any expansion card designed for use in the IBM PC/AT will function correctly when plugged into this unit. Since all printed circuit cards in the RMC-2000 are securely clamped to a shock and vibration isolated platform, the user can insert ordinary expansion cards, not ones specially prepared to withstand shock and vibration.

This product was developed through the SBIR program and was put into production in late 1987. At the end of 1988, KMSI will have produced 140 of these specialized units, twice the starting goal.

Ruggedized computers now account for about 10 percent of the company's sales of approximately $20 million. KMSI estimates 1989 sales of these computers will be double that of 1988 and expects future expansion in the military market.

CASE 8: CHARLES EVANS AND ASSOCIATES

The traditional approach to quality control for computer chips is to test each chip after it has been processed and cut from the original silicon wafer. If the wafer was imperfect, a large number of chips may need to be discarded. Having to discard a chip in the final stages of processing means that you lose the time, effort, and money put into the processing.

DoD wanted a way of testing wafers before producing chips which would be less wasteful and provide better quality control. DoD is very interested in better quality control because many of the chips used in weapon systems are made from very expensive, exotic materials.

The Company

Charles Evans and Associates, located in Redwood City, California, is a 10-year old company, started by 2 persons that now has a staff of 80, 50 of whom are Ph.Ds. They are very experienced in the field of materials testing.

> Without the SBIR program this project would never have been pursued. The results have been very exciting, not only for the current equipment and technology but for the new technologies that are evolving as a result of this research in areas such as opto-electronics and optical communications.
>
> The SBIR program is an excellent mechanism to bring new technology to the marketplace through the entrepreneurial, high-technology, small businesses in this country.

Benefits of Testing Early

Silicon crystals can now be grown with relative ease and cut into wafers, polished, and cleaned to make the basic semiconductor disks. Electronic components are added to these 6-inch disks and then the disk is cut into several hundred individual chips for use in computers, cameras, watches, calculators, automobiles, and dozens of other products. Traditionally, only after all these chips have been finished is any testing done. Quality testing at this point is very wasteful, even for silicon wafers that cost $25 each but is even more wasteful when exotic and expensive new materials are used. Such exotic materials with enhanced qualities are often required for specialized military applications, such as night vision detector arrays, raising DoD's concern with this problem.

Because silicon is cheap and the processing technology has evolved so that impurities can be controlled and yields are consistently high, it was not cost-effective to develop a way to test chips earlier in the processing. However, the yields of some of the newer, more exotic compounds are still quite low. With material such as gallium arsenide costing $300 for a 3-inch disk and compounds such as mercury cadmium telleride costing $1,000 or $2,000 for a 1-inch square, early testing becomes very important.

Testing Process

During production runs of exotic wafer material there are three areas that must be controlled. First, the ratios of the compounds in the basic material is very critical. Second, the crystallographic perfection of the wafer is important. Just as diamonds are inspected for flaws (inclusions), so must semiconductor wafers meet thresholds in this area. Third, the purity, or lack of foreign elements is important. These may be introduced during the growth process or as the material is sawed, polished, or cleaned. Common elements such as iron or oxygen are frequent contaminants.

Charles Evans and Associates has developed an instrument that can test each wafer before final production. In general, the wafer's properties will depend on its chemical composition, crystal perfection, and impurities or defects introduced during cutting, cleaning, and polishing. These factors will affect the "band gap" which is the critically important measure that determines whether the wafer can be used for its intended purpose. Charles Evans and Associates has developed a method to determine the band gap just at the end of the wafer production process.

As specialists in materials analysis, Charles Evans and Associates were able to design, construct, and evaluate an ultra-high vacuum instrument combining ion beam sputtering and electroreflectance measurement to evaluate compound semiconductor materials.

Now the testing process is being redesigned to "map" the wafers, so imperfect or impure areas can be avoided and the whole wafer need not be destroyed. Quality control not only provides greater production yields of chips, but also increases reliability of the final product.

CASE 9: OPHIR CORPORATION

Modern, computer-controlled Navy missiles and rockets can't rely on a sailor out on deck swinging a wet-bulb thermometer to give them the instantaneous humidity readings they need at the time of launching. The Ophir Corporation has developed an all weather, automatic humidity sensor to support targeting of modern weapons.

The Company

Ophir Corporation, located in Lakewood, Colorado, was founded 8 years ago and now has 22 persons on its staff. About 90 percent of its work is related to Government R&D contracts. About one half the workload is SBIR related at present.

The expertise that Ophir has established through its SBIR work has led to other Government R&D work. "We are pleased that the SBIR program has been the beginning of this successful commercial development."

Infrared Determination of Humidity

Infrared radiation absorption differs according to the humidity level. By using a sapphire window in a weather-resistant housing, Ophir Corporation was able to develop a rugged infrared marine hygrometer. This device will work even with about 20 percent of its sensor window covered with salt from sea spray. It automatically corrects for this obstruction. If the window is blocked so that performance is impaired, an alarm signals that someone should wipe off the sapphire window.

By using such a system, continuous humidity readings can be input to the sophisticated missile targeting system very easily. Other automatic devices can provide the same input, but none has the same durability when subjected to very harsh environments, including immersion in sea water.

General Environmental Measurements

This infrared measuring device can also be used in any environment where atmospheric readings are needed. Ophir had proposed this device as part of a large Navy procurement for weather equipment, but the prime contractor they were teamed with did not win the contract.

Although Ophir has sold a few units, so far the unit price remains high because of low production. With a total annual market estimated at $1 million, the cost can be substantially reduced, although probably not to the level of less durable hygrometers. To get wider distribution, Ophir has teamed with a major commercial supplier of this type of instrument who will include it in its product line. If the unit goes into higher quantity production, Ophir will also allow the larger company to manufacture the units.

This unit is also useful in any environment that is difficult to monitor, such as monitoring for water leakage in nuclear reactor cores or determining the dryness of compressed gas lines.

APPENDIX A

SMALL BUSINESS INNOVATIVE RESEARCH PROJECT SUMMARIES

SMALL BUSINESS INNOVATIVE RESEARCH PROJECT SUMMARIES

COMPANY	COMPONENT	PHASE II TITLE
Abel Company Pembroke, VA 24136	DARPA, 1983 program	Compact solar water distillation device

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Determine the feasibility of an inflatable, plastic film solar water distillation device based on charcoal cloth.

Combining laboratory and outdoor testing, charcoal cloth and hydrophilic charcoal felts were found to be the most effective solar absorbers. It was necessary to use a hydrophobic, water vapor permeable microporous liquid water barrier between the evaporation and condensing compartments.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design an emergency water purification device for use by individuals in desert regions.

A compact device capable of distilling about 1 liter of drinkable water per day was developed and tested. Ten demonstration units were delivered. There has been no feedback.

Development of fully portable, possibly expendable panels that will provide distilled and heated water simultaneously for use at forward bases and field hospitals will be explored with DoD components. There are potential commercial applications for this technology at small laboratories, factories, and some private homes.

PHASE III

Abel Company is attempting to obtain funding from DoD to develop the combined solar distillation-water heater system. The Department of Energy (DOE) was also approached for development funding but rejected the concept.

GENERAL ASSESSMENT

Small Business Innovative Research (SBIR) projects need "product champions," DoD technical personnel who will be involved with the project and make sure that projects with potential move on to Phase II and beyond.

Mr. Abel also offered several comments on improving the administration of the SBIR program. The first suggestion is for DoD to provide feedback on why proposals are rejected. This would enable a company to prepare a better proposal for the next solicitation. Mr. Abel also suggested that DoD stagger the response dates for receipt of proposals. If proposals were accepted several times a year, small companies could plan their workload better and maintain a core group of personnel. The last suggestion is for DoD to provide an instruction manual or personal computer (PC) software on Federal contract accounting.

COMPANY	COMPONENT	PHASE II TITLE
Amherst Systems Inc. Buffalo, NY 14221	SPAWAR, 1983 Navy program	Electronic countermeasure effectiveness assessment

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

To determine the feasibility of real-time assessment of the effectiveness of electronic countermeasures generated by the SLQ-32(V)3 electronic warfare system.

Results showed that real-time assessment was possible and that it could be implemented in the SLQ-32(V)3 system.

Implement the assessment algorithms in a processor system, demonstrate the system in real-time, and integrate the processing system with the SLQ-32 at Naval Surface Weapons Center (NSWC)/ Dahlgren, Virginia.

The engagement assessment algorithms were simulated and evaluated. The advantages of the approach are that it does not require changes to the current SLQ-32 system, it is portable, and it can be installed on any SLQ-32 system. Because there is no way of recording data received by the SLQ-32 antennas/receivers, some tests could not be performed.

There is no spin-off technology or commercial application for the technology.

PHASE III

The company is negotiating with Naval Sea Systems Command (NAVSEA) for funding to develop two brassboard versions for testing.

GENERAL ASSESSMENT

SBIR is an outstanding program that allows funding of high-technology content projects by small business. High-technology content means high risk and, except for the SBIR program, DoD is often reluctant to risk funding high-risk projects by small companies.

COMPANY	COMPONENT	PHASE II TITLE
ANRO Engineering Consultants Lexington, MA 02173	Defense Nuclear Agency, 1984 program	Range-gated time-domain reflectometer

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

To investigate feasibility of using baseboard reflectometry or impulse radar to detect walking, crawling, or swimming intruders around a nuclear facility.

Laboratory and mathematical analysis indicated the reflectometer concept was feasible and it was demonstrated to the contract monitor. There seemed to be military applications and, with different configurations, hardware that could be used for security of plants and homes.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Produce a model reflectometer for top-side security for Minuteman sites. A theoretical, experimental program was organized to support the development.

The first free-space impulse radar sensor in the United States was demonstrated to Government personnel in Massachusetts and in the Washington, D.C., area. The successful tests attracted the interest of all three Services and of public power representatives concerned with protecting nuclear plants.

Other short-range sensors based on this technology are being considered. As more sensitive receivers, higher power transmitters, and new beam focusing techniques are developed, the number of applications quickly multiplies. The new radar technology is a digital device having virtually no microwave components. As a result, its cost is very low.

PHASE III

ANRO teamed with Sperry Marine, Inc., for a Phase III effort. Sperry Marine bought ANRO's designs for cash and a royalty on products sold, and currently is completing a prototype radar sensor to demonstrate to DoD personnel. ANRO has been cited as one of seven companies for an award by the Innovative Development Institute. This program is the first Defense Nuclear Agency (DNA) program to reach Phase III development.

GENERAL ASSESSMENT

The SBIR program has been primarily responsible for ANRO's growth from 4 to 20 people in 3 offices. Products were developed to meet real problems using the least expensive approach. The quality of work performed may be superior to that of a large company.

COMPANY	COMPONENT	PHASE II TITLE
Applications Research Corp. Dayton, OH 45402	LABCOM (UAL), 1984 Army program	Utopia – ultrasonic interference

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Prove mathematically that it is feasible to use ultrasonic energy to diffract light to distract or deny accurate targeting information.

Ultrasonic energy can diffract light if enough energy is generated. Modern piezoelectric transducers and arrays of transducers can generate the required energy.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Verify that the diffraction phenomenon can be demonstrated in the laboratory and demonstrate that ultrasonic interferences could confuse an optical observer.

The existence of the diffraction phenomenon was demonstrated. In extending the experiment, the company found that ultrasonic energy quickly dissipates smoke. The main application for this technology is as a battlefield smoke-clearing device for the military. The technology could produce several commercial applications, such as a precipitation device for fire fighting or smoke stacks, a system to reduce the possibility of spontaneous combustion in grain elevators, or an ultrasonic clothes washing machine.

PHASE III

DoD was not able to provide additional development funding because of budget constraints. The company is exploring sources for venture capital but has not been successful. The company has a new Phase I SBIR contract to study the battlefield smoke-clearing device.

GENERAL ASSESSMENT

Applications Research believes the SBIR program is helpful to small business because it opens markets they would not otherwise consider. One complaint is that DoD does not support potential commercial applications resulting from SBIR projects.

COMPANY	COMPONENT	PHASE II TITLE
Architectural Energy Corporation Boulder, CO 80301	CERL, 1984 Army program	A comprehensive energy diagnostic procedure for large buildings

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop an integrated evaluation program to determine overall efficiency of large buildings and to diagnose specific sources of energy inefficiency.

The feasibility of the concept was demonstrated and a system of hardware, software, and procedures was conceived.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop an integrated system of building energy evaluation procedures, equipment, and software.

To evaluate energy efficiency, first a series of energy performance factors must be developed and then compare measured data from the building being evaluated to data from a building operating properly. During the first year, more than 20 performance factors were identified and more should be identified in the second year of Phase II funding. A prototype system applied to a large building identified a number of problems that would not have been identified by conventional techniques.

PHASE III

No information given.

GENERAL ASSESSMENT

The SBIR program is maturing, which means that more projects are in Phase II. DoD needs to make more money available for Phase II projects to fully take advantage of the research. This company has also experienced funding delays that can cause problems for a small business.

COMPANY	COMPONENT	PHASE II TITLE
Artech Corporation Falls Church, VA 22042	NWSC, 1984 Navy program	Metallic surfaces with high light absorption

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Test the feasibility of producing better light absorbers for use in optical systems.

Demonstrated reduced reflectance values by a factor of 2 – 3. Developed equipment capable of coating pieces that could be part of a real optical system for testing of the principle.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop capability for low-reflectance coating of baffles used in star finders.

The resulting technology will be used to reduce noise in star finder systems as they approach the sun or moon. The coating process has been developed and the company is awaiting sample baffles for testing.

Possible commercial use for satellite orientation is similar to DoD use.

PHASE III

The company plans to support the production facility in an attempt to market the coating for at least 3 years.

GENERAL ASSESSMENT

SBIR is an excellent program for taking advantage of the creativity available outside of large organizations.

COMPANY	COMPONENT	PHASE II TITLE
Atek Corporation Boulder, CO 80303	COE/CRREL, 1983 Army program	An expendable device for measuring supercooled liquid in clouds

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Prove that a vibrating wire can be used to measure supercooled liquid vapor.

Laboratory tests proved the objective.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Prove instrument can be used to measure supercooled liquid water in clouds. Deliver instrument to agency for its use.

Instrument works in laboratory conditions but not when used as a balloon-carried payload. Phase II has been extended to try to resolve problems encountered.

PHASE III

Not yet considered.

GENERAL ASSESSMENT

This instrument would not have been developed without the SBIR program. The Cold Regions Research and Engineering Laboratory (CRREL) has been very cooperative and enjoyable to work with.

COMPANY	COMPONENT	PHASE II TITLE
Band, Lavis, and Associates, Inc. Severna Park, MD 21146	NAVSEA, 1983 Navy program	Half cycle matrix system, loads, and motions

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Determine whether the half cycle matrix (HACYM) method of analyzing a random signal could be used to evaluate loads and motions at sea.

A computer program was developed to analyze analog or digital time-history data of ship loads and motions and was used to study available records. Conclusion was that a real-time display of the analyzed data would be useful during shipboard operations, particularly helicopter operations on a small ship. The automated HACYM printout from real data is a simple way to assess the characteristics of any random signal and could result in spin-off technologies.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Assemble a stand-alone computer system to be taken aboard ships at sea to help pilots when operating helicopters from a small Navy ship.

A portable desktop computer was modified to accept a continuous analog signal of ship motion; to digitize and analyze the data; and to display roll, pitch, and windspeed in HACYM format on the cathode ray tube screen. Based on experience during a North Atlantic deployment, a summary display screen was developed to tell the helicopter pilot when a lull in the motion was about to occur.

PHASE III

This technology has potential commercial application in connection with oil-drilling platforms or other sea operations. Naval Air Test Center has awarded Band, Lavis, and Associates a contract to continue developing the HACYM analyses system to use in support of V-22 maintenance tasks. It was concluded that the system would be useful one-third of the time in the North Atlantic: one-third of the time it is so calm the system is not needed and one-third of the time it is too rough to carry out operations.

GENERAL ASSESSMENT

The SBIR program provides an opportunity for a small business to develop new capabilities and to meet new potential clients.

COMPANY	COMPONENT	PHASE II TITLE
Bend Research Bend, OR 97701-8599	TACOM, 1984 Army program	On-board water generation for military vehicles

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Investigate the feasibility of a membrane-based system to recover and purify water from diesel exhaust.

It is difficult to supply potable water to troops in arid areas or where water supplies have been contaminated. Diesel exhaust contains 1 pound of water vapor per pound of fuel burned. The membrane system developed produced clear water with a relatively low level of contaminants.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design and construct three pre-prototype water purification units for testing with a military vehicle.

The first unit recovered 1/10 of a gallon of water per hour. A second smaller unit, with a higher water recovery capacity, is under construction. Water recovery from a stationary generator or from humid air streams are other potential applications.

Commercial applications include energy recovery from industrial drying processes and the dehydration of natural gas and compressed air.

PHASE III

No information given.

GENERAL ASSESSMENT

The SBIR program has given the company the opportunity to apply its specialized technology to a variety of applications.

COMPANY	COMPONENT	PHASE II TITLE
Bio-Dynamics Corporation Eugene, OR 97401	AVSCOM 1984 Army program	The design and implementation of a predictive method for the LHX pilot workload program

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Assess the feasibility of a computer-driven system evaluation process that determines the optimum combination of hardware and human subsystems in a helicopter.

Review of laboratory research in human perception and performance. New data on pilot preferences did not confirm the original results and it was determined that a battery of part tasks was needed to measure performance in an in-flight setting.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Prepare and conduct full-mission, part task, and laboratory simulations to determine mission performance differences for single and dual pilot versions of the LHX.

Developed a microcomputer-based simulator that was used to redesign the communications interface of the full-mission simulator and evaluate other subsystems, and pretrain pilots for testing of the full-mission simulator.

PHASE III

The Army has awarded Bio-Dynamics a multiyear contract to apply the microcomputer-based simulator to an automated training station and a design evaluation station. The design evaluation stations will test proposed changes to cockpit systems and determine whether the changes should be incorporated into the full-mission simulator.

The company is researching DoD for other broader uses of a flexible microcomputer-based simulator. Commercial applications will be explored later.

GENERAL ASSESSMENT

Bio-Dynamics is enthusiastic over the product developed and credits the SBIR program with the opportunity to develop it.

COMPANY	COMPONENT	PHASE II TITLE
Cape Cod Research Buzzards Bay, MA 02532	1983 DARPA program	Sea water rope batteries

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

To find a safe and inexpensive way to power devices on the ocean floor. The objective was achieved.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design, fabricate, and test a series of rope sea water batteries.

Using aluminum wire and its corrosion current along with dissolved oxygen, the company developed a safe battery at half the price of the competition. "It looks like a wire rope because it is a wire rope." Before this, ocean floor batteries cost $10,000 each and were very dangerous: a lithium battery capable of providing 2 watts for a year packs the same chemical energy as 186 sticks of dynamite.

PHASE III

The batteries are being sold commercially to the Woods Hole Oceanographic Institute and there is a Phase III contract to produce batteries for a DoD activity.

GENERAL ASSESSMENT

One of the best features of the SBIR program is that DoD technical personnel are exposed to a variety of approaches to the same problem.

COMPANY	COMPONENT	PHASE II TITLE
Charles Evans & Associates Redwood City, CA 94063	DARPA, 1983 program	Development and evaluation of an instrument for rapid electroreflectance characterization of semiconductor materials

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Assess the viability of performing electroreflectance measurements on ion beam sputtered semiconductor surfaces.

The capability was demonstrated successfully.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design, construct, and evaluate an ultra-high vacuum instrument that combines ion beam sputtering and electroreflectance measurement for compound semiconductor materials.

Studies of materials used in infrared sensing and imaging detectors were carried out with the Army's Night Vision Laboratory. Application of the instrument was also tested with several DoD contractors.

Numerous commercial applications, for example quality control, exist. Charles Evans in collaboration with several universities is exploring a spin-off technology to adapt the instrument as a diagnostic accessory for existing molecular beam epitaxy crystal growth chambers.

PHASE III

The Office of Naval Research has provided funding to use the instrument to study mercury cadmium telluride. A new Phase I SBIR contract will apply the technique to new areas.

International Telephone and Telegraph (ITT) has purchased instrument time from Charles Evans and Associates for characterization of materials produced at their processing plant. American Telephone and Telegraph (AT&T) Bell Laboratories is evaluating possible purchase as a quality control device.

GENERAL ASSESSMENT

This project would not have been pursued without the SBIR program. It is an excellent program to bring new technology to the marketplace through entrepreneurial small businesses. The program should be expanded; many good ideas are not getting funded.

COMPANY	COMPONENT	PHASE II TITLE
DAI Inc. Rockville, MD 20855	NAVAIR, 1983 Navy program	Analytical decision-making software

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate the feasibility of an automated microcomputer-based decision aid to help analyze project cost, quantities, schedules, and other economic variables.

A prototype module was designed, tested, and debugged. The module was demonstrated successfully.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Operational software plus documentation were delivered to the user. Functions include estimating routines based on unit and lot costs, learning curves, and schedule parameters; work breakdown structure; functional and financial sorting; and escalation and factoring routines. Report generation routines are also included.

Information on two Naval Air Systems Command (NAVAIR) programs has been entered into the database. The company is investigating commercial acceptance of the software.

PHASE III

No information provided.

GENERAL ASSESSMENT

The SBIR program is an excellent vehicle for small firms to investigate new technologies. It would be helpful to provide SBIR participants with a periodic list of completed research with points of contact.

COMPANY	COMPONENT	PHASE II TITLE
Datasonics, Inc. Cataumet, MA 02534	NAVSEA, 1983 Navy program	Hand-held underwater positioning system

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop, evaluate, and propose a diver-operated subsea navigation system.

Proposed system gave complete navigation capability while allowing the diver to carry tools and use his hands for tasks other than navigation.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Deliver a prototype diver-acoustic positioning system and build three production units incorporating required modifications.

Prototype system – diver subsystem, Aquanav I processor, and subsea intelligent transponders – has been delivered. Three requested modifications are being incorporated: (1) construct using nonmagnetic components and technology, (2) make the system compatible with the other Navy diver navigation system, and (3) incorporate an acoustic link allowing coded messages between diver and support vessel.

Although the primary use is military, the technology could also be used in the offshore oil industry to inspect platforms and pipelines. The acoustic telemetry link and the antimagnetic technology are possible spin-off technologies.

PHASE III

The company has no firm funding commitments but it expects to get a contract from the Navy. The company also anticipates substantial foreign military sales.

GENERAL ASSESSMENT

Datasonics has had very positive experiences with the SBIR program. The program provides a small business the opportunity to develop products that would normally be beyond its financial capabilities.

COMPANY	COMPONENT	PHASE II TITLE
DCS Corp. Alexandria, VA 22314	NAVAIR/NWC, 1984 Navy program	Analyses of an in-flight retrieval system

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Analyze an alternative method of refueling tactical aircraft to avoid devoting carrier deck space to tanker aircraft. The suggested alternative was for the aircraft to pick up fuel pods from the ocean surface.

Alternative is not viable. The aircraft will consume great quantities of fuel descending to pick up a fuel pod. This method also would make the carrier dependent on external resources to position the pods. Although the in-flight retrieval system (IFRS) is ruled out for refueling, the concept could be used for other purposes.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Evaluate the optimal sensors required by the IFRS, write a computer program to simulate IFRS performance, and build and test a scale model IFRS.

Low-light-level television cameras can be used to track the target to be retrieved. A computer program simulated IFRS performance and a scale IFRS model was built. Flights with the scale model indicated the concept had potential for practical application.

PHASE III

DoD has not provided any further funding nor have commercial applications been identified. Mississippi State University is studying the concept using their own funding.

GENERAL ASSESSMENT

SBIR is beneficial because it expands the nation's technology base. The program provides funding for innovative concepts that might not be considered otherwise.

COMPANY	COMPONENT	PHASE II TITLE
Decision Science Consortium, Inc. Reston, VA 22091	ARI/PERI-PO, 1983 Army program	Cognitive tasks and soldier-machine interfaces

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Investigate the effectiveness of alternative interfaces for allocating tasks between people and computers, and develop a method for linking human information-processing strategies to task performance.

Using an air defense-like task, results showed that performance could be maintained under high workloads by allocating the easy identification tasks to the computer and the difficult identification tasks to people.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Test hypotheses about human-computer interaction, develop a theoretical understanding of the psychological mechanisms underlying human-computer interaction, and develop a technology for predicting human-computer system performance.

Demonstrated the superiority of interfaces that allocate easy tasks to the computer while helping human operators to focus on the more difficult tasks. Results also showed the value of allowing the human operator the capability to instruct the system in performing certain tasks.

This technology is applicable to the engineering of computer displays for use under high-stress conditions (for example, the Vincennes incident). Phase II results are being used at West Point in a course on human factors.

The technology has commercial applicability to any tasks involving the identification of a large number of objects under conditions of heavy workload and uncertainty. The algorithms developed for the system are based on advances in inference theory.

PHASE III

The company is preparing proposals for several Army organizations and plans to approach the Navy also. They have also approached a private-sector corporation for additional financing.

GENERAL ASSESSMENT

SBIR benefited the company because it enabled them to bid for work on a fully competitive basis.

COMPANY	COMPONENT	PHASE II TITLE
Defense Systems Inc. McLean, VA 22102	NAVAIR/NADC, 1983 Navy program	On-the-bottom surveillance buoy

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate the feasibility of developing an on-the-bottom (OTB) surveillance system.

The analysis showed that the system concept was sound and the engineering showed that the OTB system could be packaged in a buoy that could be carried by Navy antisubmarine warfare (ASW) aircraft.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop, fabricate, and test two models of an OTB surveillance system.

The system was tested successfully in the Key West area. This is one of the first implementations of in-buoy signal processors for expendable buoys.

Spin-off technology is the application of in-buoy processing, which can be used in a variety of remote sensing applications. There is no commercial application for this technology.

PHASE III

No funding has been obtained.

GENERAL ASSESSMENT

The SBIR program is an opportunity for small business to obtain seed money for innovative ideas. Since Phase I funding is limited to $50,000, DoD can pursue several approaches to a problem at little cost.

COMPANY	COMPONENT	PHASE II TITLE
Defense Systems Inc. McLean, VA 22102	DARPA, 1983 program	Advanced acoustic communications

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate the feasibility of developing an in-water acoustic communication system.

Analysis showed that the system could be used in several different operational scenarios such as communication between two or more vehicles, control of underwater vehicles, and control of minefields.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop, fabricate, and test a prototype system.

The system was tested in a laboratory. A spin-off of the algorithms developed in this program were used in another program.

There are no commercial applications for this technology.

PHASE III

No funding has been obtained.

GENERAL ASSESSMENT

Same as for OTB system.

COMPANY	COMPONENT	PHASE II TITLE
Defense Systems Inc. McLean, VA 22102	ARI, 1984 Army program	Causal schema for interactive tactical planning

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop and evaluate a causal schema decision-aiding system. Assess the applicability to other types of decision-making problems.

Research demonstrated the applicability of causal schema to relatively unstructured problem-solving processes and produced a prototype decision-aiding system for a specific battlefield operation.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Apply the causal schema concept to a more general and complex level of planning and option generation.

Research is continuing.

PHASE III

No information given.

GENERAL ASSESSMENT

None.

COMPANY	COMPONENT	PHASE II TITLE
Defense Systems Inc. McLean, VA 22102	NOSC/NAVAIR, 1984 Navy program	Evaluation of proposed ASW weapons

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop a methodology to evaluate emerging technologies relative to one another with respect to risk, cost, and potential payoff to the Navy.

The system was developed.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Modify the system developed in Phase I and apply it to the evaluation of NAVSEA ASW weapon development programs.

The modified system was used by both NAVSEA and NOSC to evaluate ASW weapon development programs relative to one another.

PHASE III

The system with documentation was delivered and the task is complete.

GENERAL ASSESSMENT

The program allows industry to respond to real problems with proposals that require a minimum of preparation time and cost.

COMPANY	COMPONENT	PHASE II TITLE
Dynamet Technology Burlington, MA 01803	NSWC, 1984 Navy program	Fabrication and evaluation of titanium matrix cermet composites for high modulus and high temperature applications

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop a new metal-matrix composite titanium material.

Proved the feasibility of the Dynamet development.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Fabricate a new metal-matrix composite titanium material.

Optimized composition and fabrication procedures while proving the economic application for missile structures.

This material development has several military applications for jet engine components and aircraft hardware. Commercial applications include medical implants, such as hip prostheses and paper manufacturing equipment.

PHASE III

The company is trying to get the new material incorporated into missile components now in the design and development stage.

GENERAL ASSESSMENT

SBIR is a well-conceived, well-implemented program that promotes technology, innovation, small business growth as well as U.S. competitiveness in a cost effective manner.

COMPANY	COMPONENT	PHASE II TITLE
Dynamics Technology, Inc. Torrance, CA 95823	NAVSEA, 1983 Navy program	Fiber optic magnetic gradiometer

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate fiber optic magnetic sensing concept in the laboratory and derive extrapolated sensitivity for a full-scale device.

Successfully demonstrated the concept in the lab and showed adequate sensitivity for buried ordnance location. Performed assessment of sensor performance requirements.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop single-axis, self-contained fiber optic magnetic gradiometer. Characterize the instrument in the lab and in a Navy field test facility.

Developed high-sensitivity fiber optic vector magnetic transducers and a signal processing technique to derive magnetic gradient measurements from two fiber optic transducers located in a single interferometer.

PHASE III

The Naval Explosive Ordnance Disposal Technology Center is providing Phase III funding. The program requires fielding a portable 3-axis magnetic gradiometer and signal processing system capable of locating deeply buried ordnance.

The company is conducting discussions with a major oil company about applications to geophysical aeromagnetic surveying.

GENERAL ASSESSMENT

The SBIR program is extremely valuable in providing seed money to a small company to expand fundamental concepts into practical applications.

COMPANY	COMPONENT	PHASE II TITLE
E-OIR Measurements, Inc. Fredericksburg, VA 22402	DRCPM Trade, 1983 Army program	Thermal target projector

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Proof-of-concept thermal target projector (TTP) demonstrator for training thermal imaging operators to distinguish NATO from Warsaw Pact combat vehicles.

A set of infrared slides and a TTP were developed for demonstrating proof-of-concept to the Army training community. A prototype TTP was demonstrated at Fort Knox and Fort Benning.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop five proof-of-concept TTP demonstrators, including one for target search training and one that would provide for target motion cuing. In addition, develop an infrared slide library simulating the thermal appearance of combat vehicles under summer and winter battlefield conditions.

Proved the concept and trained thermal imaging operators in optimum use of sights. Developed photographic and infrared slide process and target insertion techniques and a microprocessor-controlled scroll drive. Demonstrated an infrared scroll slide using the TTP. Developed a low-cost training device for recognition proficiency and a filmstrip that simulates scanning capabilities. Established an infrared slide library.

E-OIR has developed a portable minimum-resolvable temperature difference tester for field or laboratory use as a spin-off from the project.

PHASE III

A follow-on contract to maintain the five TTP units is under consideration. No commercial applications for this technology were identified.

GENERAL ASSESSMENT

Excellent program. SBIR offers small business the funding to exploit new ideas and concepts.

COMPANY	COMPONENT	PHASE II TITLE
Electromagnetic Sciences, Inc. Norcross, GA 30091	BRDC, 1984 Army program	Broadband microwave absorbers

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Evaluate the effectiveness of highly anisotropic hexagonal ferrite media as a microwave attenuator/absorber for radar cross-section reduction.

Phase I demonstrated the effectiveness of ferrite uniaxial hexagonal and spinal compounds with predictable and controllable properties. Phase II was an extension of Phase I except that more flexibility was allowed in the selection of materials.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Investigate the properties of sample coatings in a laboratory setting, write computer programs to help design coated plates, and fabricate coated plates.

An automated optimization program was developed to design the multilayer plates. The fabrication of coated plates was developed into a controlled and repeatable process. Low- and high-power millimeter wave test and evaluation of the ferrite materials and devices was conducted. The results will have a significant effect on DoD and NASA radar and communications systems.

PHASE III

There were no DoD funds available to pursue the microwave absorber. Since DoD would be the principal user of the product, no efforts have been made to sell it commercially.

GENERAL ASSESSMENT

Electromagnetic Sciences, Inc. benefited from the program and recommends it be continued.

COMPANY	COMPONENT	PHASE II TITLE
Eltron Research, Inc. Aurora, IL 60504	ONR, 1984 Navy program	Photointercalating semiconductor/solid electrolyte junctions for storage and chemical detection

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Evaluate the technical feasibility of applying solid polymer electrolytes in novel all solid-state photoelectrochemical storage cells.

Various solid-state cells were fabricated and photoelectrochemically and electrochemically investigated. The feasibility of the technique was demonstrated. The research effort also produced a novel technology for the direct conversion of incident illumination into stored electrical energy and an approach for chemical detection of gaseous species.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Complete the technical characterization of photointercalating semiconductor/solid electrolyte junctions for both photoelectrochemical energy storage and chemical detection applications.

Capacitance, impedance, and admittance studies were performed on single crystals of several materials. A multiple-reflecting optical wave guide was investigated for the direct detection and measurement of gaseous sulfur dioxide. Solid-state electrical energy storage devices are expected to emerge from development of this technology.

PHASE III

Eltron has a funding commitment with IEG Venture Management, Inc., and is exploring the possible commercial applications of the reversible sulfur dioxide chemical detection technology.

GENERAL ASSESSMENT

The SBIR program is an effective way of encouraging new and innovative high-technology concepts.

COMPANY	COMPONENT	PHASE II TITLE
Energy Conversion Somerville, MA	DARPA, 1984 program	Safe high-power-density lithium battery

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Measure the performance and capacity of lithium chloride (Li/SOCl2) cells with TAA-catalyzed disk electrodes.

The performance measured was sufficient to project that a fully packaged cell could be made that would meet the power density goal of 400 watts per kilogram with high-energy density.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design and test two types of cells that are capable of high peak pulse power on a continuous low rate drain.

Design and laboratory testing is completed. Testing of prototype cells over a broad temperature range and under severe working conditions is continuing.

Because of the SBIR project, the company has acquired equipment necessary to develop other types of lithium battery cells and is proceeding with an in-house research program.

The company has begun to market the technology to companies supplying data-logging instrumentation and DC-DC converters.

PHASE III

The batteries cannot be used in DoD systems until the battery has been qualified by the appropriate DoD agencies. The company plans to seek qualification at the end of Phase II.

The company plans to use its own resources to acquire the capital equipment necessary to manufacture the cells developed.

GENERAL ASSESSMENT

Because of the SBIR program the company was able to develop a new product they anticipate will be profitable.

COMPANY	COMPONENT	PHASE II TITLE
Essex Corporation Orlando, FL 32803	Army Medical Research Acquisition Activity, 1984 program	Development of a test battery for assessment of human performance

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Conduct a literature review of the effects of vehicle vibration and motion on human performance.

Literature review revealed a dearth of studies on the effects of vehicle dynamics on skilled behavior in humans.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Provide a psychmetrically sound, computerized, portable test battery for studying decrements in human performance.

Produced a portable test battery to determine effects of stressors such as loss of sleep, workload, chemical substances, cold, and hypoxia that may interfere with an operator's performance. The test battery would have commercial applications in any area where it is important to study the effects of stressors on human performance. Potential examples are to study the effects of toxic waste, hazardous materials, food additives, controlled substances, alcohol, or dietary supplements.

PHASE III

The company has no Phase III funding yet.

GENERAL ASSESSMENT

The SBIR program is an excellent opportunity for small businesses to develop innovative ideas.

COMPANY	COMPONENT	PHASE II TITLE
Eureka Laboratories, Inc. Sacramento, CA 95823	NAVAIR/NAEC, 1984 Navy program	Robotic deck scrubber

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Perform preliminary design of a robotic deck scrubber with distributed (multiprocessor) intelligence. Demonstrate the obstacle avoidance capability of the robot.

The technical specifications were defined based on Navy requirements. The company demonstrated the obstacle avoidance capability of the robotic design during locomotion.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Produce a prototype of a robotic deck scrubber that will efficiently clean a hangar deck with minimum supervision.

A prototype capable of cleaning a user-defined area while avoiding obstacles was completed. The prototype can operate automatically or can be controlled by the user.

Spin-off technologies are possible for general application to mobile robots and for the obstacle avoidance algorithm developed for the project. The technology has numerous additional applications for military and commercial use. The robot could be used to clean warehouses or other large areas. Other applications for a mobile robot include fire fighting, security patrolling, farming, and nuclear waste clean-up. With slight modification, the robot can be used as a robot janitor to increase efficiency of cleaning staffs or for home use to vacuum and clean floors.

PHASE III

DoD may order several units for field testing. The company plans to build an additional unit for marketing purposes. Full-scale manufacturing for commercial purposes is anticipated.

GENERAL ASSESSMENT

SBIR provides an opportunity for small businesses to carry a feasible technical concept through to a product.

COMPANY	COMPONENT	PHASE II TITLE
Flow Research, Inc. Kent, WA 98032	ONR, 1983 Navy program	Ocean instruments for boundary layer measurements under ice

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Test the feasibility of using a diode laser in an underwater laser doppler velocimeter. Prepare the system for a field test in the ocean boundary layer.

Development of a design for a boundary layer instrumentation system capable of measuring turbulent fluxes in the marginal ice zone.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop and field test a diode laser doppler velocimeter (DLDV).

A DLDV was developed to measure currents and turbulence at both arctic and temperate latitudes. The system was designed to be deployed from floating ice floes but can be deployed from a stationary platform also.

The DLDV has potential commercial applications for measurement of particle speed and size distribution, or for monitoring chemical and combustion processes. Additional applications are possible by adding direction sensing capabilities.

PHASE III

Flow Research and Washington University have submitted a joint proposal for DoD to purchase the DLDV. DOE is funding additional work to add direction sensing capabilities. The company is pursuing commercial sales also.

GENERAL ASSESSMENT

The opportunities provided through SBIR are not usually available to a small business unless it has an extensive marketing department.

COMPANY	COMPONENT	PHASE II TITLE
Foster-Miller, Inc. Waltham, MA	NAVSEA, 1983 Navy program	Ventilated band seals for diesel pistons

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Analyze, design, and test a novel piston ring to be used in high-performance diesel engines such as might be used in small boats, generator sets, and minesweepers.

The tests showed low levels of leakage and ring-friction force at low levels of compression pressure. Design and fabrication experience was gained.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate the ring in a single-cylinder diesel engine, including forcing the engine to high cylinder temperature.

Phase II demonstrated that the ring can be integrated with standard engine components. Performance at full throttle is about 3 percent better than with stock components. Leakage and life are comparable to stock parts.

The sealing concept has been applied to a rotary high-pressure mud seal in a rock bit for DOE.

PHASE III

A proposal for the Air Force to use the concept for high temperature hydraulic seals was rejected because of lack of funds. The company is trying to interest the Army or the Navy in demonstrating the ring in a low-heat-loss diesel.

Foster-Miller has contacted and received inquiries from several large manufacturers of diesels, compressors, and injectors.

GENERAL ASSESSMENT

The concept developed under this SBIR award has potential but it is in an established market. The R&D would not have happened in the commercial sector. SBIR projects that don't succeed have a purpose; they keep a prod in the side of the established commercial structure and they provide invaluable learning experiences for the more free-wheeling segment of the nation's technology base.

COMPANY	COMPONENT	PHASE II TITLE
Foster-Miller, Inc. Waltham, MA 02254	BRDC, 1984 Army program	Reverse osmosis water purification

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Determine the feasibility of using centrifugation to replace the multimedia filter currently used on the reverse osmosis water purification unit (ROWPU).

Centrifugation removed turbidity from water adequately. Use of a centrifugal clarifier instead of the current multimedia filter would maintain processing capability while reducing weight and size.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design, fabricate, and test a skid-mounted centrifuge for use in the Army's breadboard testing of their high-tech ROWPU under development.

The test centrifuge (ROWPUFUGE) is an alternative to the mixed-media filters now in use. ROWPUFUGE can provide continuous operation at less weight and size. More testing and at least one more design iteration are required before the centrifuge can be introduced into the ROWPU system. The technology addresses a specific Army need and there are no commercial applications or spin-off technologies.

PHASE III

Follow-on funding is doubtful. The Army has not completed development of the ROWPU system yet.

GENERAL ASSESSMENT

SBIR is an excellent method of investigating new technologies and developing prototype equipment for the military.

COMPANY	COMPONENT	PHASE II TITLE
Foster-Miller, Inc. Waltham, MA	Natick RDEC, 1984 Army program	Portable personal cooling system

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Design, build, and demonstrate a breadboard cooling system that can be carried by a person.

A miniature freon compressor was developed and successfully operated. The test program showed that the concept was sound and that refinements would lead to a reliable, compact, and lightweight cooling backpack.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Refine the existing system with special emphasis on weight reduction of the condenser and evaporator, and development of a more suitable multifuel engine.

A smaller and lighter model was produced while maintaining the same thermal output. Electronic temperature and engine controls were added for automatic modulation of the cooling output.

The multifuel version is expected to have many additional applications for the military. Commercial uses of the portable cooling system include fighting fire, repair and maintenance in thermal power stations, and steel mills.

PHASE III

Foster-Miller has submitted proposals to DoD for portable personal cooling systems that would be part of self-contained toxic environment protective outfits (STEPO).

GENERAL ASSESSMENT

The Army received two prototype units for a relatively small investment. In addition, the company was able to establish leadership in this area.

COMPANY	COMPONENT	PHASE II TITLE
Franklin Engineering Co. Ann Arbor, MI 48105	COE/CRREL, 1983 Army program	Pneumatically de-iced ice detector

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Design an ice detector that can function with low power consumption and can operate in remote locations for extended periods.

Current techniques require electrical power for de-icing heaters and experience ice bridging to the mounting support, which obscures the capability of the instrument to detect ice. A pneumatically de-iced structural ice detector was designed, constructed, and demonstrated that is capable of detecting the onset of icing, wind detection, wind velocity, and temperature.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Construct a new battery-powered instrument and demonstrate its remote operation capability.

The instrument performed as an ice detector without the ice bridging problems. An important by-product was the demonstration of the all weather anemometer capabilities since current instruments are quickly disabled during icing conditions.

Military applications include an all weather anemometer for battlefield operations, airports, helicopter sites, remote VSTOL/STOL operations, and observation stations.

The instrument can also be used for commercial airports. The ice detector would alert airport operations to the onset and extent of icing as well as the cessation of icing conditions. The anemometer capabilities would provide a pilot with actual wind conditions on the runway. The system can also provide detection of abnormal wind conditions for incoming and outgoing aircraft.

There has been some interest in the de-icing boot technology for removal of destructive ice from cables and towers.

PHASE III

No Phase III funding as yet. The instrument developed will be part of an ice detector test program being conducted by the Federal Aviation Administration in fall of 1988. The company has submitted a proposal for a South Polar remote installation funded by National Science Foundation (NSF).

GENERAL ASSESSMENT

SBIR is a wonderful opportunity for a small business to express ideas and obtain funding to assist in development. One problem with the program is that a small business that has completed an SBIR project and developed a successful product does not get any recognition for this among other agencies or sponsors.

COMPANY	COMPONENT	PHASE II TITLE
Fuzetron, Inc. La Mesa, CA 92046	NAVSEA, 1983 Navy program	Radar cross-section coatings to reduce reflectance

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop a hard, durable radar attenuating material (RAM) good for saltwater conditions.

The coating developed passed a 3,000-hour salt spray test and achieved a good radar cross-section reduction.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop the coating process to apply the RAM to shapes and angles, and to develop RAM designs for various broad bands and band specific frequencies. The coating technology must not pollute the atmosphere as solvent-based coatings do.

Specific attenuation was achieved. The method is called polymer "powder coating" and the coating usually is cured in a closed oven. Fuzetron was able to cure the powders with infrared heaters instead. Use of 100 percent solids coatings as a binder for RAM also was tested. Neither solids nor powder coatings polluted the atmosphere.

The resulting coating is harder and more durable than standard paints and general purpose coatings. The technology could be applied commercially throughout the powder coating industry.

PHASE III

The company has pursued a follow-on contract with DoD and numerous sources of venture capital. No contracts or sales have resulted.

GENERAL ASSESSMENT

The SBIR program is very competitive. It should be expanded because the Government receives good value for the money spent.

COMPANY	COMPONENT	PHASE II TITLE
General Technology Applications, Inc. Manassas, VA 22110	NAVSEA, 1983 Navy program	Safe/economical processes for rocket and gun propellant manufacture

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate the feasibility of a new and unique classified process for the production of gun propellant.

The feasibility of the process for making gun propellant was demonstrated using a simulant for the energetic material.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop, procure, test, and evaluate all components of the complete process for the production of a LOVA gun propellant.

The LOVA formulation is considered superior but has not been used because of processing problems. The process developed under this contract circumvented those problems and tests were completely successful.

The process could be applied in the fields of filled polymer, filled elastomer, filled ceramic, and filled metal. The company is working with the Army to apply the process to the production of tread pads for the M-1 tank.

The company has used the process to manufacture filled rubber composites with improved properties.

PHASE III

General Technology Applications is working with the Navy to design, build, test, and operate a gun propellant production plant for the Army. The company produces and sells additives for oil spill recovery and drag reduction in pipelines that apply the technology developed.

GENERAL ASSESSMENT

The individual and small company with useful ideas is invariably stymied by financing requirements. Banks, private industry, and even venture capitalists are not prepared to finance the risks inherent in true innovation. The SBIR program is the most successful approach in tapping the well springs of innovation.

COMPANY	COMPONENT	PHASE II TITLE
Guild Associates, Inc. Columbus, OH 43229	SGRD-MRDC, 1983 Army program	High-capacity portable oxygen systems

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop lightweight, high-capacity portable oxygen systems for battlefield medical support.

Guild adapted its existing small-scale pressure-swing adsorbtion (PSA) cycle development unit to cycle conditions that met military specifications and demonstrated acceptable performance levels and made preliminary design studies to support development of prototype equipment. It demonstrated that the equipment was a viable alternative to supply forward positions with a continuous oxygen supply.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Produce four prototype oxygen generators that would withstand testing at environmental extremes with minimal modification.

The task objectives were achieved. Guild is financing further endurance testing on its own. Related to its SBIR work, Guild won a competitive contract for the field medical oxygen generation/ distribution system (FMOGDS). Guild will develop large oxygen generation systems for field hospitals. They have also discussed licensing the technology for commercial markets.

PHASE III

The SBIR product has not received further funding. The spin-off technology could have a major impact on the FMOGDS program.

GENERAL ASSESSMENT

Guild is extremely supportive of the SBIR program. Innovations from the program help promote "technological thriftiness" for the United States and can help to revitalize the industrial base.

COMPANY	COMPONENT	PHASE II TITLE
High Technology Sensors, Inc. Longwood, FL 32779	Medical R&D Center, 1984 Army program	Novel multisensor chemical detector

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Determine feasibility of using a new solid-state infrared source within a chemical detection and measurement system. Gases from helicopter munitions and exhaust enter the cockpit affecting pilot performance. Current gas sensing systems do not work within an operating helicopter.

The technology was tested and determined adequate to build a portable gas sensor.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop a solid-state multisensor chemical detector system capable of profiling gases within a helicopter.

A prototype sensing device capable of incorporating eight sources for gas detection was designed, fabricated, and delivered to the Army. The system includes auxiliary sensors to measure pressure, temperature, humidity, and air flow.

The company has a patent pending on the device. The technology developed will be used in another SBIR project for the Navy titled, "Miniature Respiratory Sensor." The system can be used to measure ambient air quality in moving vehicles such as cars, trains, airplanes, and helicopters but the company feels there is only limited commercial application for the device.

PHASE III

No DoD contract has been awarded. The company is negotiating with a medical instrument company for the development and production of a miniature respiratory sensor and has preliminary commitments of venture capital to commercialize the gas sensor technology.

GENERAL ASSESSMENT

The SBIR program is extremely beneficial to the DoD and the economy. Problems included the funding gap between Phase I and Phase II, the difficulty of transitioning Phase II technology into a Phase III contract, and the lack of awareness of the program in the venture capital community.

COMPANY	COMPONENT	PHASE II TITLE
Hygeia Inc. Waltham, MA 02154	COE/CERL, 1984 Army program	A portable light-phase contrast microscope

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Design and fabricate a prototype instrument for analysis of asbestos in construction materials in the field.

Analytical reports from outside laboratories often take up to 6 weeks to identify the presence of asbestos. A field-portable microscope would enable industrial hygienists and safety personnel to detect asbestos on site. A prototype microscope that uses polarized light microscopy was constructed and tested.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Add a phase contrast microscopy feature to the instrument and develop a 1-week training course for Army personnel.

The instrument Hygeia developed incorporates both polarizing light microscopy and phase contrast microscopy in one instrument. The portable microscope costs approximately one-half that of commercial instruments now on the market.

PHASE III

No information given.

GENERAL ASSESSMENT

Researchers at the company had given much thought to this type of instrument but would not have been able to develop it without SBIR support.

COMPANY	COMPONENT	PHASE II TITLE
Information Research Associates Austin, TX	NSWC, 1984 Navy program	High-level simulation of electronic systems

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Determine the feasibility of extending an existing modeling system to high-level simulation and modeling of electronic systems.

The new modeling system was developed and applied to several realistic electronic design problems. The results established the feasibility and attractiveness of the modeling system.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop a prototype of the new design and modeling system.

The prototype successfully modeled two realistic electronic design systems. The prototype was demonstrated at the 1988 Design Automation Conference.

The work reinforced the feasibility of the previously developed technique of using a hierarchy of directed graphs to model system designs. The company continues to use the technique to develop other products.

PHASE III

The Navy received a copy of the prototype but has not funded any further work. The company will finance commercialization from sales of other products. It expects commercial sales to begin in fall of 1988.

GENERAL ASSESSMENT

The program is beneficial to Government and small business when the proposals are sound to begin with. The SBIR program should not finance projects that the company could finance itself. The Government should have limited supervision and reporting for SBIR projects.

COMPANY	COMPONENT	PHASE II TITLE
Intercon Systems Corporation Rockville, MD 20850	Navy (Marine Corps) 1984 program	MIFASS/TCO preplanned improvement

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Perform a line of code (LOC) estimate to determine if the tactical combat operations (TCO) requirements could be supported by the proposed Marine Integrated Fire and Air Support System (MIFASS).

LOC estimates indicated it is not feasible to expect the MIFASS architecture to support LOC requirements for the TCO application.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop a generic specification for the MIFASS architecture to evaluate the specification against user requirements. Also investigate the feasibility of speech processing in the architecture as an alternative to keyboard transactions.

The company developed a top-level specification for the MIFASS architecture and performed experiments in speech processing using the Kurzweil system in conjunction with the computer systems being evaluated for the project.

PHASE III

The MIFASS program was canceled so there is no DoD follow-on work.

GENERAL ASSESSMENT

The SBIR program can provide quick results that would have taken much longer to obtain through normal contracting methods. The projects are easy to initiate and administer.

COMPANY	COMPONENT	PHASE II TITLE
J. Stafford Associates San Mateo, CA 94402	NSWC, 1984 Navy program	Improved design for isocon cameras in the HERTR system

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Improve the performance of existing HERTR camera systems.

The HERTR systems suffer from a design shortcoming. Improvements that fix the design fault were demonstrated.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop a camera chain that reflects current technology.

The program is still in process. Current sensor devices have improved enough to make development possible.

The technology can be applied in both military and commercial laboratories, particularly those that require very stable and repeatable procedures. A lens developed during the project is a potential spin-off technology for applications where very fast, close conjugate imagery is desired.

PHASE III

Phase III funding has not been sought since the product has not been delivered. The current sponsor has limited use for the technology but other Navy research contractors might be interested.

GENERAL ASSESSMENT

SBIR has been very useful to accomplish technological progress without the usual bureaucratic interference. It should be continued and expanded.

COMPANY	COMPONENT	PHASE II TITLE
Klein Associates Inc. Yellow Springs, OH 45387	Army Research Institute for the Behavioral and Social Sciences, 1984 Army program	A knowledge elicitation methodology for representing naturalistic decision making

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Study how people make decisions under extreme time pressure.

Developed a paradigm for studying fireground commanders to derive a model of naturalistic decision making. In order to do the study, developed a critical decision method (CDM) for eliciting knowledge.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Evaluate CDM and demonstrate its applicability to other problems and domains.

The method was demonstrated. Military applications include evaluation of decision-making systems, development of command-and-control training programs, and on-site documentation of decision making during command post exercises.

The CDM has commercial applications for evaluating expert systems and decision training.

PHASE III

Klein Associates has internally funded development of training packages for commercial application.

GENERAL ASSESSMENT

The SBIR program has been very valuable. The products developed should benefit DoD as well as commercial sponsors.

COMPANY	COMPONENT	PHASE II TITLE
KMS Industries, Inc. Ann Arbor, MI 48106-1567	NAVAIR/NAC, 1984 Navy program	Low-cost ruggedized microcomputer

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop a design for a low-cost ruggedized microcomputer.

The microcomputer design must be suitable for use in Navy I-level and O-level maintenance shops and should use current common microcomputer hardware and software. The design met the requirements, including ability to withstand shipboard environment.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design, develop, fabricate prototypes, and test a family of ruggedized IBM PC/AT/XT compatible microcomputers.

The test program is still in process. The company has received military designations for two of the units. There has been no spin-off technology.

PHASE III

Units have been sold to several Government customers including Canada, NASA, and the Air Force. Prime contractor customers include AT&T, E-Systems, Texas Instruments, California Microwave, and Zeta Laboratories. The company will continue to finance additional marketing to supply the ruggedized microcomputers as stand-alone units or as part of a total system.

GENERAL ASSESSMENT

The SBIR program is very beneficial to small businesses. However, funding delays between Phase I and Phase II can cause problems.

COMPANY	COMPONENT	PHASE II TITLE
Maxdem, Inc. Pasadena, CA 91105	SGRD-RMA, 1983 Army program	Portable emergency oxygen concentration

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Evaluate the feasibility of using an electrochemical process to produce a stream of pure oxygen from ambient air.

Proved that oxygen could be produced electrochemically as long as anhydrous, aprotic solvents were used.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop portable oxygen concentrator for emergency medical use. The issue was whether the electrochemical oxygen separation could be produced in aqueous media without significant loss in efficiency.

The aqueous technology was developed but the efficiency was very poor and the process proved to be impractical. There is no current use for the technology.

PHASE III

There is no Phase III effort.

GENERAL ASSESSMENT

Without SBIR, Maxdem would not have been able to undertake the program. It was a high-risk effort, but the idea, if it had proved out, would have been a significant advance in medical equipment technology for DoD's use. If it had succeeded both DoD and the company could have benefited.

COMPANY	COMPONENT	PHASE II TITLE
MSNW, Inc. San Marcos, CA 92069	LABCOM/MTL, 1983 Army program	Joining technology: preparation and evaluation of reduced heat input electroslag welds of heavy-section aluminum armor

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Examine high-rate, low-cost alternative processes for welding heavy-section aluminum plate.

Demonstrated process and identified problem areas needing further development.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Problems identified in Phase I included need to reduce contamination levels, improve soundness, etc.

Weld quality improved but not enough for commercial use. There is no military or commercial potential at this time. The process is under study for use in structural applications such as bridge construction and ship construction.

PHASE III

The company is continuing development with internal funding.

GENERAL ASSESSMENT

The SBIR program has been very helpful in providing seed funding. In all cases, SBIR work led to further development or investment.

COMPANY	COMPONENT	PHASE II TITLE
Nielsen Engineering and Research, Inc. Mountain View, CA 94043	NSWC, 1984 Navy program	Submarine launched ballistic missile underwater launch trajectories

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop a method to predict the trajectory of a submarine launched ballistic missile between launch and broach.

The feasibility of the prediction method was demonstrated.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Produce a computer code to implement the prediction method.

The project is still in process.

PHASE III

No Phase III funding yet.

GENERAL ASSESSMENT

SBIR provides a way for a small business to do research for which it would not otherwise get funding. However, the long delay between Phase I and Phase II can cause hardships on small companies.

COMPANY	COMPONENT	PHASE II TITLE
Odetics, Inc. Anaheim, CA 92802	LABCOM/HEL, 1984 Army program	Articulated manipulator

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Prove high-strength-to-weight manipulator with articulated joint.

Demonstrated 200-pound lift at full 6-foot reach.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Improve design and increase lift to 300 pounds and reach to 8 feet.

An operational articulated manipulator with 300-pound lift and an 8-foot reach was delivered for testing. Military applications are in explosive ordnance disposal, refueling, mine warfare, and remote material handling.

PHASE III

No Phase III funding.

GENERAL ASSESSMENT

Excellent program but some SBIR projects selected to serve specific DoD needs are used as "budget extenders."

COMPANY	COMPONENT	PHASE II TITLE
Odetics, Inc. Anaheim, CA 92802	NSWC/NAVSEA, 1984 Navy program	Shipboard fire fighting vision systems

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Perform feasibility analysis of various technologies for fighting fires on shipboard.

Completed a survey and evaluation of technologies. Determined that vision enhancements for obscured environments are key to remote technology applications.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Prove principal multisensor vision testbed with sensor fusion processing to see visually and thermally through fire-created opacity.

The testbed was built and operated successfully. Optimal performance for fire-related environments and remote surveillance was determined.

There is no commercial application for this technology.

PHASE III

The company is submitting an unsolicited proposal to DoD to tailor the products further.

GENERAL ASSESSMENT

The SBIR program is extremely helpful for new entrants with new ideas.

COMPANY	COMPONENT	PHASE II TITLE
Ophir Corporation Lakewood, CO 80235	NAVAIR, 1983 Navy program	Durable infrared humidity sensor for shipboard

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Study the feasibility of using infrared humidity sensor technology in the harsh marine environment.

Conducted extensive infrared spectrophotometer tests on sapphire window. Completed a preliminary hardware design for a marine sensor.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design, construct, calibrate, test, and deliver a shipboard infrared hygrometer.

The hygrometer was delivered to the Navy. Advantages include extremely fast response time, high sensitivity, continuous output, low maintenance, and a stainless steel housing with sapphire optics that are impervious to salt spray accumulations.

Commercial applications include ground-based and airborne fast-response humidity sensors, humidity sensors for scientific research, and industrial devices for sensing humidity in on-line process control. The company developed a variant of the technology for use in gas-cooled nuclear reactors under a DOE contract. Ophir has a patent pending on the device.

PHASE III

The company has bid on a Navy contract to deliver the hygrometer. It has used internal funds to develop a commercial version of the marine hygrometer.

GENERAL ASSESSMENT

The SBIR program was the beginning of a successful commercial development.

COMPANY	COMPONENT	PHASE II TITLE
Pinson Associates, Inc. Austin, TX 78766	LABCOM/VAL, 1983 Army program	Doppler chaff

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Determine the feasibility of a radar countermeasure in the form of an expendable decoy that produces a realistic aircraft radar signature.

The technique uses nonlinear chaff dipoles that are illuminated with microwave energy and reradiate radar signals that closely resemble aircraft radar signature with realistic doppler characteristics. The feasibility of the technique was demonstrated.

The mathematical model developed for the nonlinear dipole led to spin-off technology in other fields, such as nonlinear plasma effects in fusion research, nonlinear effects of wave motion in offshore drilling, and radar detection of unintentional nonlinear radar targets.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design and fabricate a sample of prototype nonlinear dipoles and the required illumination equipment. Conduct a field demonstration of the decoy capabilities.

Phase II is about 30 percent complete. Small quantities of nonlinear dipoles were tested and better than expected results were obtained.

Nonlinear analysis has many potential applications. DoD use includes detection of radar targets and fault isolation in a range of components from printed circuit boards to jet aircraft turbine blades.

Commercial applications include automobile collision avoidance systems, airborne collision warning systems, detection of flow in underground pipelines, and passive location of downed aircraft and avalanche victims.

PHASE III

No financing has been arranged.

GENERAL ASSESSMENT

Innovative ideas may be developed in performance of a contract that are of no interest to the sponsor. SBIR is a way to keep those ideas alive long enough for them to become viable products or processes. A secondary benefit occurs from university contact and university research that can stimulate new applications and alternate approaches.

Criticisms are lack of communication and funding delays. Better information on the status of proposals would be helpful. Long delays were experienced before a contract was signed.

COMPANY	COMPONENT	PHASE II TITLE
Pinson Associates, Inc. Austin, TX 78766	LABCOM/VAL, 1983 Army program	Radar tracking against chaff

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Design a small multichannel digital filter that uses radar cross-section and spectral width as radar input parameters to discriminate aircraft from chaff.

A unique indicator was found that could reliably identify aircraft in the presence of chaff.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Design and fabricate a brass board model to use on a radar to demonstrate the validity of the technique. Conduct a limited flight test of the technology.

Phase II is about half completed. The brass board model has been designed and is being assembled. The flight test demonstration is scheduled for the end of 1988.

Commercial applications are somewhat limited. Possible applications are improved tracking of civilian aircraft through rain and severe weather, and in the NEXRAD weather radar being developed by the Weather Service.

PHASE III

No information on Phase III funding.

GENERAL ASSESSMENT

Innovative ideas may be developed in performance of a contract that are of no interest to the sponsor. SBIR is a way to keep those ideas alive long enough for them to become viable products or processes. A secondary benefit occurs from university contact and university research that can stimulate new applications and alternate approaches.

Criticisms are lack of communication and funding delays. Better information on the status of proposals would be helpful. Long delays were experienced before a contract was signed.

COMPANY	COMPONENT	PHASE II TITLE
Powertronic Systems, Inc. New Orleans, LA 70189	NAVSEA, 1983 Navy program	Low-harmonic 400-hertz line voltage regulator for shipboard power-systems

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate validity of a low-harmonic 400-hertz line voltage regulator.

Designed, built, and tested a breadboard system. It provided the desired performance characteristics.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Further demonstrate validity of low-harmonic 400-hertz line voltage regulator with a prototype unit.

Designed, built, and tested a prototype voltage regulator that met the Navy's goals for the application. The prototype was given to the Navy for further testing under simulated shipboard conditions. A prototype 60-hertz unit also was built and evaluated. The unit offered superior performance at a price comparable to competing commercial units.

A patent was obtained on the 60-hertz unit for commercial applications. Some spin-off technology may result from the knowledge of high-frequency power and electronic circuits gained from the research.

PHASE III

The company expects to receive contracts from the Navy for both the 60-hertz and the 400-hertz line voltage regulators for shipboard applications. It also plans to license the technology to larger companies to manufacture and market the low-harmonic line voltage regulators.

GENERAL ASSESSMENT

The program is beneficial to both Government and small business. The only criticism is that the administrative action by the Government is slow, causing staffing and financing difficulties for the small business.

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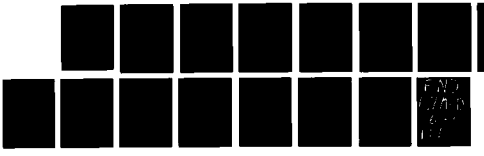

COMPANY	COMPONENT	PHASE II TITLE
Quantum Design, Inc. San Diego, CA 92121	NAVSEA, 1983 Navy program	An improved optically pumped magnetic detector for locating deeply buried ferrous ordnance

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate the feasibility of a new type of magnetic detector for locating buried ordnance.

Demonstration of the atomic precession experiment upon which the magnetic detector is based. The successful demonstration of the physical phenomena gave a strong indication that the detector was feasible.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate an improved magnetic detector based on the free precession of potassium atoms.

Demonstration of a free-precession magnetic detector with a sensitivity 10 or more times greater than previous optically pumped magnetic detectors. The detector can be used to locate buried ordnance, concealed explosives, underwater mines, and submarines.

Commercial applications include oil and minerals exploration, and research in geophysics and earthquake prediction.

PHASE III

The company is exploring potential additional funding with the Navy.

GENERAL ASSESSMENT

The new technology demonstrated here would have been difficult for a company the size of Quantum to develop under conventional funding. SBIR helps to build one of the most vital segments of the economy and the research community.

COMPANY	COMPONENT	PHASE II TITLE
R-K Research and System Design Malibu, CA 90265	NAVMED, 1984 Navy program	Computer-aided instructional module for the NOHIMS

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Design a computer-aided instructional module for training users of the Navy Occupational Health Information Management System (NOHIMS).

The resulting design was a MUMPS-based intelligent tutoring system called ABC. It was designed to apply to a wide range of system applications.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop an adaptive, generic computer-aided instructional module for training users of the NOHIMS.

MUMPS has been adopted as one of DoD's official programming languages. In the current implementation, ABC functions as an embedded training system and on-line help system for users of MUMPS-based ABC information management applications. ABC is a computer-based instructional system for developing modifiable, interactive instructional software for MUMPS-based systems.

The Veterans Administration (VA) uses MUMPS and there is a large user community outside of VA and DoD. ABC provides an adaptive, generic tool for generating computer-aided instructional modules for MUMPS-based systems. The techniques are general enough to extend to other uses.

PHASE III

No further DoD funding is anticipated. The company is marketing the system on its own.

GENERAL ASSESSMENT

This project would not have been possible without SBIR funding. The SBIR program provides a unique mechanism to encourage development of innovative ideas, concepts, products, and processes among small business entrepreneurs.

COMPANY	COMPONENT	PHASE II TITLE
Radiation Monitoring Devices, Inc. Watertown, MA 02172	SPAWAR, 1984 Navy program	Personal digital neutron dosimeter

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop a small, sensitive digital personal dosimeter that will measure neutron exposure over a wide range of neutron energies.

Completed conceptual design including selection of the memory device for the sensor and research on techniques to make the sensor sensitive to a wide range of neutron energies.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Build a prototype dosimeter.

A breadboard system was built and tested that had the desired characteristics.

PHASE III

No funding from DoD or potential commercial partners was obtained. The company continued development on its own and funding was obtained from NSF to build a neutron spectrometer based on the technology.

GENERAL ASSESSMENT

The SBIR program allowed the company to expand staff and increase its capabilities.

COMPANY	COMPONENT	PHASE II TITLE
Scientific Research Associates, Inc. Glastonbury, CT 06033	ONR, 1983 Navy program	Propeller tip vortex analysis

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate feasibility of computation of tip vortex calculation for marine propellers.

The capability was successfully demonstrated.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Perform a high Reynolds number analysis of the propeller tip vortex generation process. The completed analysis will be delivered soon. The results should lead to quieter submarines. With modifications, the technology can be applied to the NASA turbo prop program.

PHASE III

No information provided.

GENERAL ASSESSMENT

SBIR is a valuable program to encourage emerging technologies.

COMPANY	COMPONENT	PHASE II TITLE
Sensor Electronics, Inc. Mt. Laurel, NJ 08054	SGRD-RMA, 1984 Army program	Noise suppressing talk-through ear plugs

PHASE I and II OBJECTIVES AND ACCOMPLISHMENTS

Develop an earplug hearing protector with talk-through communication capability.

Developed a prototype of an active earplug equipped with an earphone transducer, a miniature microphone which can be placed inside the ear canal, a differential pressure seal earplug, and an active aural noise reduction system.

As a result of the project, the company developed several proprietary features in the field of active noise cancellation.

PHASE III

No further funding from DoD has materialized. Venture capital sources want to participate only after an idea has been proved.

GENERAL ASSESSMENT

The program administration was efficient and effective. The Contracting Office Technical Representative (COTR) contributed to the effectiveness of the project.

COMPANY	COMPONENT	PHASE II TITLE
Springborn Laboratories Enfield, CT 06082	CERL-PP/COE, 1984 Army program	Coating system for submerged steel substrates

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Develop and evaluate innovative resin systems for use in formulating a coating for submerged steel substrates.

Polysulfide/epoxy hybrid systems were identified as the most promising candidates for producing underwater coating systems.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Identify the most promising system and complete formulation by selecting barrier pigments, fillers, and other additives needed. Develop an application method to ensure effective and efficient application of the coating.

Developed an innovative paint system for coating submerged steel substrates. The coating offers improved service life, better adhesion, and easier application than underwater coatings currently available. The Corps of Engineers (COE) can use the system for coating dams, locks, and other submerged steel structures that need corrosion protection.

The paint system can be commercially applied to any submerged steel structure. The technology will lead to development of coatings that can be applied to unprepared structures.

PHASE III

Springborn Laboratories has found significant interest from paint formulators in developing the coating system.

GENERAL ASSESSMENT

The SBIR program has helped the company apply its expertise to a wide variety of research and development programs involving polymeric materials.

COMPANY	COMPONENT	PHASE II TITLE
Star Microwave Campbell, CA 95008	SPAWAR, 1984 Navy program	Technology for low-cost traveling wave tubes for expendable microwave countermeasures

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Identify technologies and demonstrate feasibility for reducing the cost of traveling wave tubes (TWTs) for expendable countermeasure transmitters.

Demonstrated electron gun, microwave circuit, and beam focusing technology. Phase II was funded to incorporate this technology into an experimental TWT. The electron gun technology was used immediately to build broadband TWT for on-board countermeasures and communications.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate a TWT with a fast-starting cathode designed for low-cost manufacture.

Low-cost electron gun and microwave circuit design were demonstrated together; fast-start cathode was demonstrated separately.

Phase II results led to a subcontract to develop and supply TWTs for an off-band expendable countermeasure system.

No commercial use for this technology has been identified.

PHASE III

The company expects a contract with a prime contractor supporting the Navy.

GENERAL ASSESSMENT

Star Microwave has produced six major innovations in the microwave tube area from SBIR funding.

COMPANY	COMPONENT	PHASE II TITLE
Texas Research Institute, Inc. Austin, TX 78733-6201	NAVSEA, 1984 Navy program	Rubber-to-metal adhesive systems

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Demonstrate that the addition of silane coupling agents to a commercial adhesive system primer would improve the resistance of the rubber-to-metal bond to cathodic delamination.

The demonstration was successful.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Develop a new primer containing silane coupling agents for marine applications, particularly sonar transducers.

The new bonding technology has been incorporated into the Navy's TR-317 sonar transducer head mass assembly.

3M was contacted for commercialization but considers the market too small. The project generated ideas about bonding to unprepared surfaces that resulted in a successful proposal to develop a primer for oily surfaces for the Army.

PHASE III

No further DoD contracts have been obtained as yet. Texas Research will use the technology at Actran Systems, Inc., a subsidiary that manufactures sonar transducers.

GENERAL ASSESSMENT

I believe the SBIR program is good for DoD, the small business community, the academic community, and the nation as a whole.

COMPANY	COMPONENT	PHASE II TITLE
Universal Energy Systems, Inc. Dayton, OH 45432	LABCOM/MTL, 1984 Army program	DLC coatings for optical systems

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Find the parameters of the process that produce the best adhesion, determine the properties of the coating, and determine the reproducibility of the process.

Diamondlike carbon (DLC) films on semiconductor substrates did not loosen when exposed to strong acids, organic solvents, steam, or extremes of temperature. The study found that DLC films adhere to several common materials used for infrared optics also. An alternative technique for depositing DLC film on soft surfaces, such as mercury cadmium telluride, was recommended.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Prepare DLC on actual Army infrared optical materials and demonstrate the durability of DLC to ballistic impact and adverse chemical environments. Deliver a spectroscopic ellipsometer capable of determining optical properties of materials over a wide range of wavelengths.

DLC film can be coated on the surfaces of infrared detector materials to provide better wear and corrosion resistance. DLC film can provide wear and corrosion resistance on military aircraft canopies.

Commercial applications include wear, scratch, and corrosion resistance for tail lights on aircraft and automobiles, and environmental protection for laser quartz windows.

PHASE III

No information available.

GENERAL ASSESSMENT

SBIR provides a small business with limited resources the opportunity to explore high-risk innovative research. Results can lead to the next generation of products and processes.

COMPANY	COMPONENT	PHASE II TITLE
Wyatt Technology Corporation Santa Barbara, CA 93130	CRDC, 1983 Army program	Submicron particle analyzer

PHASE I OBJECTIVE AND ACCOMPLISHMENTS

Establish design and operational characteristics of a real-time submicron particle analyzer.

The design was completed and feasibility confirmed.

PHASE II OBJECTIVE AND ACCOMPLISHMENTS

Fabricate and test two units.

The two units were delivered and are fully operational. An additional new unit is being fabricated for the Bureau of Mines. The company is marketing a commercial unit for research laboratories.

Some of the electronic developments are spin-off technology that will be used in other company projects.

GENERAL ASSESSMENT

SBIR is a first-class program of great help to the company's technological development.

APPENDIX B

COMMENTS ON THE PROGRAM BY SMALL BUSINESS INNOVATIVE RESEARCH PARTICIPANTS

COMMENTS ON THE PROGRAM BY SMALL BUSINESS INNOVATIVE RESEARCH PARTICIPANTS

As part of the investigation, each participant in the Small Business Innovative Research (SBIR) program was asked to provide general comments on the program. This appendix consolidates and summarizes their comments. The Logistics Management Institute has not analyzed the suggestions or made judgments as to their accuracy or worth.

Universally, participants praised the SBIR program. It is difficult to find a Government program which is so well liked, even by those firms that did not receive support beyond the initial stage. "Work is performed in a competitive environment through an abbreviated, efficient, and rapid proposal evaluation and contracting process." "Good for DoD, the small business community, the academic community, and the nation as a whole." " . . . an astute stroke by Congress, one which holds promise of coming of age at a crucial time in U.S. history."

FINANCIAL SUPPORT

Several firms spoke of the general financial support that the SBIR program provides for small businesses doing innovative research. "SBIR allows the funding of high technology content programs performed by small companies." ". . . valuable source of support for new and innovative projects . . . ." ". . . helps to build one of the most vital segments of the economy and the research community."

Many of the participants noted that the project that they had worked on would not have been done except for the SBIR program. "Even though we had given this project considerable thought prior to Phase I award, we could not have developed the concept without SBIR support." "The SBIR program was the only way . . . ." ". . . not have been able to develop the products otherwise." ". . . would not have been fully developed or tested without the SBIR program."

Negative Comments – Financial

A small percent of the participants voiced some negative comment regarding funding, the most common concerning the time period between phases of the

program. Most SBIR contractors already experienced in Government contracting regard the SBIR program as very streamlined, but for many small businesses the funding gaps were of serious concern. Several pointed out the difficulty of supporting their project team during these gaps.

Long administrative delays were by far the most significant negative comment. One firm was distressed that nearly twice the number of Phase I topics are issued than there is money to fund and that DoD has only one selection cycle for new programs each year.

Although DoD provides for bridge funding, this has not solved the problem for many participants.

Suggestions - Financial

Several firms suggested that more money be made available for the program. One thought the Phase I limit should be raised to $100,000 over a 12-month period. One suggested a specific approach to covering the funding gap between phases. One thought only the topics that would be funded should be solicited. Due to the delays, "Inflationary pressures make it very difficult to complete the project within the originally proposed cost estimate and I feel that the quality of the research suffers as a result of these delays and poor communication."

Since Phase II programs are funded with cost-type contracts which are unfamiliar to most of the small businesses involved, it was suggested that the SBIR office fund the development of a good, simple personal computer software package and understandable instruction book to provide an accounting and control system needed for cost-type Federal contract accounting. It could be updated annually to take into account changes in Federal Acquisition Regulations and other regulations, including Internal Revenue Service tax accounting.

BENEFITS

DoD/Nation

Over 25 percent of the firms specifically mentioned the program benefits to DoD and the nation as a whole. Several expressed the belief that, for relatively small sums of money, a lot of product was produced. It was noted that only a few "winners" would be needed to pay for the rest. "Even duds keep a prod in the side of

the established commercial structure, and they provide invaluable learning experience . . ."

The possibility of becoming more competitive world wide, restoring technological leadership, and thus keeping the U.S. deficit in check was discussed. The competitiveness of the SBIR program was mentioned, as were the benefits to the Government's technical experts who gain the benefit of reading numerous approaches to a problem all for free.

Firms

Companies in the SBIR program believe their company has received general benefits from this association. This has involved such things as enhancing technological capability and development, and penetrating marketplaces that otherwise would not have been considered.

"The SBIR program is extremely valuable in providing seed money to our small company to expand fundamental concepts into practical applications." ". . . able to demonstrate the feasibility of innovative new processes and to attract major commercial partners with the goal of product commercialization."

Cooperation Enhanced

In some cases, the SBIR project involved several groups including other firms, universities, and DoD research facilities. In another case, "It provided college students with an opportunity for hands on research and lab experience and thus contributed to the quality of their education."

In some cases, firms stated that they had received major benefits from the SBIR program by virtue of the fact that they had further contacts with colleges or universities. This provided important new approaches to the immediate technical problem and prompted participation in technical symposia which stimulated commercial application ideas and foreign sales possibilities.

New Area

Over one-fifth of the firms brought up the fact that the SBIR program with which they were involved had brought the company into a new area. In some cases the SBIR program participation provided indirect help by establishing contacts and the chance to become aware of other business opportunities unrelated to the SBIR

project itself. In many cases the SBIR project was credited with allowing the firm to progress so fast in a particular area that they were now a leader in that field.

"The SBIR program has been the beginning of successful commercial development, resulting in a pending patent, and more than $8 million in additional Phase III sales proposals of this technology are now pending." "Have hired three individuals, have developed in-house technical expertise of general utility to other company programs, and have established the technical basis, including manufacturing equipment and experience, for a product line . . . ." ". . . able to expose its researchers to a wide variety of state-of-the-art developments . . . ." "The SBIR program . . . has changed our thinking about the type of company we are."

Increased Staff

Other firms noted significant growth in employment as the result of the program – ". . . growth from 4 to 20 people . . . ." Also, as a result of the SBIR program, one firm noted that it was able to hire better, more experienced scientists and engineers.

GENERAL

Negative Comments

Three firms were frustrated by the inability to proceed further with their project. Another thought that the interaction with and reporting to the Government was a significant burden. One thought the Phase I and II time period of 2½ years was too short. Two believed that some topics were so narrowly written that only certain firms would qualify and that another firm might have been set up just to attract SBIR grants.

Suggestions

Two companies suggested that firms be notified promptly when a proposal has been rejected and of the reasons for the rejection. A debriefing should be automatically offered covering both positive and negative aspects for each proposal. A periodic list of completed research, with points of contact, should be provided to those firms that request the annual solicitation.

Each project should have a product "champion" who would participate from the first day of the project and guide successes into further contract opportunities in Phase III. Interviews with firms reinforced the benefit of having a champion.

Other general comments included a suggestion that DoD have a large, project-specific solicitation plus a smaller, general-mission solicitation. "The government should concentrate on selecting sound projects for funding and then using limited supervision and reporting." "Do not let complacency or politics turn the SBIR program into another industry welfare program."

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DoD's SBIR program is a congressionally mandated program wherein a small percentage of its R&D awards are set aside exclusively for small businesses. Its objectives are to stimulate technological innovation in the private sector, to strengthen the role of small business in meeting DoD research and development needs, to foster and encourage participation by minority and disadvantaged persons in technological innovation, and to increase the commercial application of DoD-supported research and development results.

The projects studied for this report were begun in FY83 and FY84. Many are on the verge of commercialization while others that show great promise are still in the final stages of development. Research under the SBIR program covers virtually all scientific disciplines. For example, the Army has funded projects to provide potable water to troops when local water is unavailable or undrinkable. The Navy has funded several proposals involving tools and materials that can be used underwater. A project to develop a safer way to manufacture explosives may provide a new processing technology that can be applied to many other products, both commercial and military.

We concluded that the Small Business Innovative Research (SBIR) program is accomplishing its goals. The program reaches a variety of small businesses from one person working independently to established companies with several hundred employees. Participants like the program and are enthusiastic about continued participation. New products and processes are being introduced into the DoD inventory and many of the products have commercial applications as well.

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